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ABSTRACT

An attempt to evaluate the effects of individualized vision training in a group of grade-4 children who were both disabled in reading and diagnosed as having inadequate vision skills is reported. The effects evaluated include both changes in vision and the relationship of vision training to change in reading achievement. Experimental cases received vision training. Both the experimental and the control cases received four vision analyses and psychological evaluations. Thirty-one of the cases were followed through a 2-year procedure, and 22 of those cases were included in the final statistical analyses comparing experimentals with controls. The Bender Visual-Motor Gestalt Test, when scored by the Koppitz scoring system, did not predict underachievement in reading and may not be sensitive to visual-motor development at grade 4. The experimental and control groups did not differ from each other in either reading achievement or disability throughout the study. Pursuit fixations, near point of convergence, saccadic fixations, and perceptions of diagonals showed improvement with vision training. No change was noted in group mean intelligence scores. Tables, charts, references, and appendixes are included. (Author/WB) children'saggressive behavior at preschool. (DR)

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FINAL REPORT

Project No. RF1603

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THE INFLUENCE OF VISION TRAINING UPON THE SUBSEQUENT READING ACHIEVEMENT OF FOURTH GRADE CHILDREN

Charles B. Huelsman, Jr. Ph.D.
The Ohio State University
Research Foundation
1314 Kinnear Road
Columbus, Ohio 43210

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The study reported in these pages was conducted over a five-year period. The conducting of the study required the coordination of members of the Optometric profession, of educators, of parents and children and of local staff personnel. The cooperation of all these people has made this study possible. A central committee of optometrists served as regular consultants in the study. Drs. Lois Bing, Nathan Flax, Harold Friedenberg, Paul Lewis, and Henry Quick served on this committee from its beginning. Drs. H. Ward Ewalt and Daniel Woolf and Dean Alfred Rosenbloom served with the committee at various times during the five-year period. Dr. Leo Manas of the Northern Illinois College of Optometry served as a special consultant on test scoring. Dr. Howard M. Snyder assisted in the interpretation of various vision test scores during the latter stages of the project. While these optometrists individually and collectively contributed to the study and its progress, responsibility for the conduct of the study, its conclusions, and the final report rest with the author.

Sixteen optometrists were involved with vision analyses and vision training of the subjects in the study. This group included the following: Drs. Harold Friedenberg of Richmond, Virginia; Morton Davis of Bethesda, Maryland; Lawrence Gould of East Setauket, New York; F. Milton Hathaway and Lynn Allen of Pontiac, Michigan; Bernard Keisler of Irwin, Pennsylvania; Ben Lane of Lake Hiawatha, New Jersey; Albert Miller of Hamilton, Ohio; Ruth and Warren Morris of Toledo, Ohio; Henry Quick of Owego, New York; Jerome Rosner of Oakmont, Pennsylvania; Kenneth Steward of Ferndale, Michigan; Norman Tursh of Paterson, New Jersey; Robinson Weltner of Uniontown, Pennsylvania; Mary Ruth Winebrenner of Muncie, Indiana; Irving M. Woodrce and J. Baxter Swartwout of Troy, New York; Daniel Woolf of Summit, New Jersey.

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Psychological and remedial reading services were contributed by the local school districts when they were available. When they were not available, these services were supplied with financial contributions from the study.

Originally, 134 school systems were asked to participate in the study by agreeing to have some of their students selected as subjects. Of the 30 school systems which agreed to participate, the following schools were attended by subjects selected and followed during the course of the project:

Angling Road of Southfield in Ferndale, Michigan
Boyle, Gallatin, and East End in Uniontown, Pennsylvania
Deerfield in Summit, New Jersey
DeVeaux in Toledo, Ohio
Edith A. Bogart in Paterson, New Jersey
Fairfield West in Hamilton, Ohio
Green Meadow and Donald P. Sutherland in East Greenbush, New York
Hartford Heights in Irwin, Pennsylvania
John Hill and School Street in Boonton, New Jersey
Lincoln in Muncie, Indiana
Owens and Mark Twain in Pontiac, Michigan
Port Jefferson in East Setauket, New York
St. Bridget's in Richmond, Virginia
Twinbrook in Bethesda, Maryland
Washington Gladden

Many of the cooperating school systems made their own psychological and remedial services available to subjects included in our study. Where these services were not available within the school system, professionals approved by the respective schools were contracted by the project. In both cases, psychologists and remedial tutors were an integral part of the research, and the study depended heavily on their services. Psychologists involved with the finally selected subjects were: Richard Cadarette, Edith J. Crawley, Norma Louise Fosnaugh, Eleanor Friedenberg, Kenneth R. Greenberg, Paul Hill, Walter Herrmann, Glenn Irwin, Pierce McLeod, Nellie Morrison, John F. Murray, Spencer Pride, William Robertson, Alan Romanella, Theodore Ronsvalle, Alvin Sheetz, Robert A. Sizemore, and Leonard Van Arsdale.

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Abstract

The study is an attempt to evaluate the effects of individualized vision training in a group of fourth grade children who are both disabled in reading and diagnosed as having inadequate vision skills. The effects evaluated include both (1) changes in vision and (2) the relationship of vision training to change in reading achievement. The study attempts under "rigid" conditions to replicate what has been observed in office practice.

The research design involved the participation of optometrists, school personnel, psychologists, and remedial reading teachers in ten states. Potential disabled readers (N 10,071) were selected by group test scores and 444 were referred for individual psychological evaluations. Children who were reading at an age level of one or more years below mental age level were referred for vision analyses.

The final sample consisted of 32 fourth graders, disabled in reading and each of whose vision analysis indicated the need for vision training. Experimental cases received vision training after which both experimental and control subjects received (1) second vision analyses and second psychological evaluations; (2) remedial reading instruction; (3) third vision analyses and psychological evaluations; and (4) several months later, fourth vision analyses and psychological evaluations. Thirty-one cases were followed through the two-year procedure, and 22 of those cases were included in the final statistical analyses comparing experimentals with controls. Data collected during the subject selection process were analyzed to answer other questions.

School administered group test scores of intelligence and achievement that were reviewed for this research indicated that 10% of the fourth grade population in those schools were underachieving in reading by one year or more. Of those potential disabled readers, 370 received complete psychological evaluations and 35% were reading at one or more years below mental age expectancy, indicating a 65% over-referral. Of the 59 children reading one or more years below mental age who received vision analyses, 39 (67%) were diagnosed as able to profit from vision training.

The Bender Visual-Motor Gestalt Test, when scored by the Koppitz scoring system, does not predict underachievement in reading. The test may not be sensitive to changes in visual-motor development at the fourth grade level.

Form 11, a test requiring copying and reversing of diagonals does not differentiate underachievers from achievers in reading. It does seem to measure changes during vision training however. Scores of

experimental cases improved and were significantly better than controls after training, after both groups received remedial tutoring, and at follow-up.

Both experimental and control groups increased in reading age scores and both groups increased in reading disability scores, however, the groups did not differ from each other in either reading achievement or disability throughout the study.

Of the vision tasks measured and compared throughout the study, pursuit fixations, near point of convergence, saccadic fixations, and perception of diagonals (Form 11) showed improvement with vision training. Pursuit fixations is the only one of these measures that showed improvement after training without showing improvement at follow-up.

There was no evidence of change in group mean intelligence test scores from the first psychological assessment to any of the other evaluations during the course of the study, for either experimental or control group.

The attrition rate of subjects in this study differs significantly from the attrition rates in individual private practices as measured by one-year records for fourth grade students seen in the offices of four of the five leading vision training specialists. Office practice seems to have higher or lower attrition rate depending on clientele. Some optometrists, for example, accept patients for vision training only upon referral from another optometrist.

These findings are not considered as valid empirical tests of the impact of vision training on reading achievement. Significant aspects of the study may well lie in its by-products, the vision training manual, the vision testing manual, and the heuristic value of implications for further research into vision training.

CHAPTER I

Introduction to the Study

Individuals who are blind or whose visual acuity is marginal either cannot learn to read, or find it extremely difficult to do so via the visual sensory mechanism. It is not as obvious, however, that vision is more than visual acuity and that the ability of many individuals to learn is often imparied by one or several vision inadequacies. Examples of vision factors and thereby of potential visual inadequacies are accommodation (the ability to maintain clear vision as the target nears the eyes), convergence (the inward movement of the eyes to maintain single vision as the target nears the eyes), motility (the ability to move the eyes - in saccadic or in pursuit fixations - smoothly and accurately), phoria (the relative posture of the eyes horizontally and/or vertically when no fusion is present), and fusion (the ability to integrate and use the visual information received from two eyes).

There is little doubt that visual perception skills are conditioners of the learning-to-read ability of the child. Visual perception, in terms of awareness, discrimination, retention, and recognition, is a prime factor in the learning-to-read process. It is important that the young reader learn to visually perceive form as early as possible, enhancing his aptitude for learning to read. The general problem of the present study is whether training in the vision skills that make perception possible are also associated with reading achievement and the process of learning to read. The current study takes a significant step toward answering the question.

It is the contention of many that some of these vision factors are learned and that inadequacies may be corrected by appropriate teaching called vision training. An increasing number of optometrists are offering vision training services to their patients. Many of them see children become able to learn as a result of vision training. However, with presently available evidence, hypotheses regarding the relationship of vision training to reading achievement can be neither rejected nor accepted. The study, then, attempts to create the situation during which careful, complete, scientific observation of patients may be carried out during vision training, replicating office practice to see if what is seen by vision training specialists can also be seen under vigorous study conditions.

If the "removal" of vision inadequacies through training results in a reduction of the number of children who fail to learn to read and/or if this removal results in an increase in children's reading achievement, a way will have been identified to promote the achievement and subsequent societal contributions of these children. The specific problem, then,is one of discovering (1) whether or not vision training results in improved visual skills, and (2) in turn whether vision training is related to the improvement of reading achievement for children who are known to be disabled in reading.

In the remaining sections of Chapter 1, vision, perception, and vision training are discussed in greater detail. Presently available research is reviewed and the questions considered in the study are then stated.

The Concepts of Vision

Parents, teachers, optometrists, and ophthalmologists hold various concepts of vision. The concepts held by any individual dictate how he wishes vision to be defined, examined, screened, and researched. The concepts of vision can be considered readily from a chronological point of view. In the following paragraphs six concepts are considered in historical order.

The first of these concepts, and certainly the basic one, is vision or blindness, an either-or proposition--either you see or you do not. This concept is implicit in the commendable campaigns for eye safety and eye health. Blindness (even of only one eye) is a catastrophe and should be prevented. Everything should be done to remove even the remotely possible incidents that could lead to blindness. School vision programs that screen children from the point of view of eye health often present this concept. All optometrists and ophthalmologists (called refractionists in this text)include it in their definition of vision and, apparently, there is no controversy over the concept as a definition of vision. Society is concerned with the prevention of blindness and should be. Historically, however, blindness is not the sole concept of vision.

The Snellen chart was introduced with the second concept of vision: acuity, sharpness of vision, or degree of blur. One can conjecture that its introduction caused a controversy in the nineteenth century. The date accepted by Spache (1965) is 1862. In many schools today and in many doctors' offices, the sole means of vision screening is the Snellen chart. The Snellen chart was an excellent improvement over the void that existed before it. Even as late as the 1920's, it was considered satisfactory for the times as an instrument for use in screening the vision of large numbers of people. When far point activities were man's chief means of earning his living and achieving personal safety, the measure of far point acuity (tested with the target at 20 feet) was of primary importance. Since 1920, however, man's vision activities have shifted from a predominance of far point to primarily near point (for example, reading distance, 16 inches). Recently, for the first time, the labor force of white collar workers, who work almost exclusively at near point, exceeded the number of blue collar workers. Furthermore, increasingly more tasks of the blue collar workers require near point rather than far point visual activity. Among primitive tribes or peoples today, one would not expect the measure of near point acuity or glasses for reading to be of much value. In today's modern world, the measure of far point acuity as the exclusive means of testing vision may well be both anachronistic and misleading.

In some schools, reduced Snellen figures are presented at near point and acuity is considered at both far and near points in vision screening. This is, of course, an improvement; however, the exclusive use of Snellen figures implies a definition of vision limited to visual acuity. The acuity definition of vision points out that those who are not blind see with varying degrees of acuity depending upon illumination, distance from the target, chronological age, and the ability of the eye to perform. Acuity, or sharpness of vision, is measurable and subject to treatment, usually through lenses. Most refractionists include acuity in a definition of vision.

Blindness and acuity are the most widely accepted concepts of vision. Vision practitioners, refractionists, have noted that near acuity often differs from far and that left eye acuity often differs from that of the right. Unequal acuity may be the result of another vision problem or it may result in other vision problems or both. Without consciously realizing it, the patient having unequal acuity may experience discomfort, or he may suppress the vision of either eye or of each eye in a pattern of alternation. Whenever binocular vision is involved, the individual whose eyes work together in an unstable way, as in suppression or alternating or partial suppression, is visually ineffective or inefficient. When monocular vision is essential (as in sighting or aligning), the individual who can see with one eye and suppress the other voluntarily has an advantage. When practitioners consider the way in which the two eyes are used together they are considering binocularity (the third concept of vision).

Refractionists often measure the acuity of two eyes simultaneously (binocular acuity) as well as the acuity of each eye independently (monocular acuity). It has often been assumed that binocular acuity would be the same as the acuity of the better eye or as the acuity of the preferred eye. Although often true, it is not always true since refractionists note with many patients that binocular acuity is better than or poorer than the acuity of either eye. This is an illustration of the differences of the present report from classical concepts of acuity.

A binocular problem may exist with unequal acuity, but even when the acuity measures of the eyes are identical, the possibility of other kinds of binocular problems exists. An individual may have acquired a tendency for his eyes to point irregularily in the horizontal and/or vertical planes. The individual who has difficulty in converging his eyes accurately for near point activity or for any activity between near and far points is ineffective in binocular visual reach, grasp, and release. Reach, grasp, and release may be restated as looking directly toward a target (without false moves), holding the fixation, and moving easily to the next target. The individual who experiences difficulty in coordinating the convergence mechanism (external eye muscle activity that makes the eyes point inwardly) with the accommodation mechanism (interior eye muscle activity that keeps the retinal image clear or unblurred) must somehow adapt or alter his own accommodation-convergence relationship. Visual performance for certain tasks may be adequate but in other tasks inadequate, thus reducing the variety of seeing situations with which the individual can cope. Some individuals fail to use two eyes simultaneously and suppress as described above. Amblyopia, or loss of visual acuity through disuse, may result from continued suppression. This type of amblyopia, thus, may be considered an adaptive change permitting the partial continued function of vision, but reducing the individual's range of available visual responses. The practitioner often finds it difficult to predict how an individual will reorganize his visual patterns when faced with an obstacle to vision.

Judd and Buswell (1922) pointed out that binocularity is a part of the act of reading. He noticed the convergent and divergent movements a at the beginning of lines in the eye-movement records. If a child has two healthy, functioning eyes, he must coordinate two sets of electrochemical neural activities--one set from each retina--whenever he sees. He sees _two_ with his eyes, but _one_ with his mind. If the child who has difficulty with clear single binocular vision is to succeed in learning to read, he must learn to suppress either one eye (or a part of one eye) all of the time, or alternately to suppress first one eye and then the other. The child who skips or repeats words, or who covers one eye while reading (especially after 10-15 minutes of reading) may well suffer from a binocular problem. If he skips or repeats lines rather than words within a line, his problem may be correspondingly greater. The child with the "minor" binocular problem may well be in greater difficulty in learning to read than the child with the major problem. This point of view varies from the classical point of view found so often among today's eye-health specialists.

Binocular vision, then, as a concept includes the acuity relationship between the two eyes, the relative posture, the convergence ability, fusion, and the relationship between accommodation and convergence. (This list is intended as illustrative rather than as exhaustive.) An individual who has trouble with binocular facility may modify vision in order to achieve (good reader with vision problems), or he may keep his visual function relatively intact and not achieve (poor reader without vision problems, who would have vision problems if he tried to learn to read). On the other hand, he may be unwilling to _give up either_ vision skill or reading achievement and struggles unsuccessfully to keep both (poor reader with vision problems). The illustration of the complicated relationship between binocular vison and reading achievement is further complicated by the fact that inadequacy of reading achievement has causes other than vision.

Binocularity, as a concept of vision, is not yet as firmly entrenched as acuity. There are some refractionists who do not include the binocular function of the eyes in their definition of vision.

The 1930's produced a fourth concept of vision, that of vision skills. Skills in depth perception and in fusion were first measured routinely during this period. To these have been added accommodative skill and both accommodative and convergence reserves. Depth perception fusion, and convergence are interpreted as binocularity. The skill with which they are used is interpreted as vision skill. Convergence skills include both the manipulative skill in bringing the eyes simultaneously and quickly upon the target and the power skills of holding for long periods and under conditions of stress and of shifting (releasing). (A student preparing for a quiz has placed himself in a situation involving stress.) Accommodative or focus skills are also twofold: (a) the speed with which clarity of target is achieved, and (b) the maintenance of clarity for long periods and under conditions of stress. Vision skills, then, include the manner in which an individual uses accommodation and convergence and the amount of stress he can tolerate while using them.

Skill in following a target (motility--pursuit fixation) is essential in hunting and in sports as well as in learning. Skill in keeping the two eyes focused and converged on words and skill in moving the eyes to the next words (motility--saccadic fixation) are essential in learning to read. Skill in maintaining clear single vision for longer and longer periods of time is essential for learning from books and in many other near-point tasks such as cartography, painting, and drafting, where longer periods of concentrated near-point activity are required.

Vision skills as a concept is broadening. Indeed the concept of vision itself is broadening. There was a time when vision was considered only in terms of defects. In fact, many people, if not most people, think of vision in such terms today. Vision skills, as a concept, is not as widely accepted as blindness, acuity, and binocularity; however, the term binocular vision skills is coming into more frequent use.

Visual perception is a concept in the process of being added to the definition of vision. That vision has a perceptual character is not obvious to some. If one eye is covered there is no area without "sight" despite the fact that the retina of the eye possesses an area where it is physically impossible to see (the blind spot). However, the field vision experienced through the open eye is complete. Too, as one approaches an object, say from 20 feet to 2 feet, it does not seem to change size yet the size of the image on the retina becomes many times larger. This phenomenon of visual experience stability is called perceptual constancy. Boring (1946) wrote of constancy a quarter of a century ago. Although the percept is not the object perceived, the person doing the "seeing" makes no distinction between the visual experience and reality, between the proximal percept and the distal percept.

Such tests as the Street Gestalt Test and the Perception Speed subtest of the Thurstone Primary Mental Abilities tests were early measures of visual perception. In the first, the individual uses his retention of previous percepts to fill in missing parts and, in so doing, to recognize the picture. In the Perception Speed test, the individual searches for the detail that will enable him to discriminate the differences and similarities among four drawings and to recognize the two that are identical in terms of significant detail. The Bender, the Frostig, and the Illinois Test of Psycholinguistic Abilities are frequently used at present. While the concept of perception is probably universally accepted and while the concept of visual perception is also widely recognized, visual perception is not universally accepted as an integral part of vision. However, failure among practitioners to agree on the relationship between vision and visual perception is more likely to occur regarding (1) the nature of visual perception, and (2) the possibility of altering visual perception through training. One group of vision practitioners views visual perception as reserved for psychologists and educators. Psychologists may view visual perception as innate, as a product of maturation, or as a phenomenon to be treated apart from the problems of vision. Some psychologists and a second group of vision practitioners view visual perception as an integral part of the act of vision and as an aspect of vision subject to change through training. Educators are beginning to explore the possibilities of visual perception training with kindergartners and first graders and with such exceptional children as the mentally retarded and the learning disabled.

Regarding visual perception as a part of the definition of vision, some practitioners exclude it as the province of other professionals. Some professionals believe that perception cannot be changed through training. Other practitioners and some other professionals include perception in the definition of vision and believe that it can be changed through training. In part, this study attempts empirically to test the latter hypothesis.

The sixth, and most recent, concept of vision adds meaning or significance to the definition. Its proponents suggest that no act of vision can be complete without meaning. For example, if the driver of an automobile sees another automobile approaching and makes an adjustment in direction or speed, he does so because what he sees has meaning. However, even though it is highly improbable that an act of vision could occur without meaning in some degree, the question remains as to whether the meaning is a part of vision or apart from vision, whether it is an integral or separate psychological event. A few refractionists include meaning as a concept within the definition of vision. Fifty years from now it may well be commonly included.

In the present study, vision is defined as encompassing all six of the concepts described above. Greater emphasis in the study has been placed on binocularity, skill, and perception.

Percepts, Perception, and Perceivers

In the preceding section, the fifth concept of vision refers to the inclusion of visual perception in the concept. In this section, perception as a concept is presented in greater detail. Perception is an important element within the present study and a somewhat more than cursory understanding of it is necessary for an understanding of the research. Perception is defined (English and English, 1958, 378) as an event within a person "primarily controlled by the excitation of sensory receptors" but influenced to an important degree by factors within the person.

Any such event (a percept) must have substance, that is, there must be sensory input resulting from energy that emanates from some source. Furthermore, these percepts have characteristics that appear to be unchanging. However, it also appears that the activity of the perceiver changes. These three, the percept, its characteristics, and the activity of the perceiver, are considered in greater detail below.

Percepts: A percept is a psychological event and not an object. If a subject looks at a window, his experience of seeing the window is not the window itself. Thus, a percept is not the object which is perceived but rather the "internal" event itself. Normally, one can expect a high degree of correspondence between the object (the distal percept) and the perception of it.(the proximal percept). In fact, it would be unusual for a perceiver to make a distinction between the two. With primitive peoples one might not expect such a correspondence when mirrors, movies, pictures, and TV are perceived for the first times. Whenever some aspects of the object are omitted or presented in unusual ways, as in illusions or in distortion experiments, the correspondence can be reduced, demonstrating incidentally that the object and its perception, while related, are not identical.

One of the complicating aspects of perception lies in the fact that perception occurs regarding so many different substances. According to English and English (1958, p. 378), a few psychologists doubt that perception is a class of events having sufficient unity for scientific inquiry.) Nonetheless, we have thought of the substance of perception as things, movements, change, ideas, self, and others.

Probably the simplest of the percepts are things; destal percepts which occupy space or time and which can be experienced through any of the sensory modalities would be classified as things; thus a drawing of a triangle, a triangle itself, a scissors, a book (that is, a physical book), an automobile, a house, a necktie clasp, the ticking of a watch, the blowing of an automobile horn, or the sound of a doorbell would each be classified as a thing. All of these occupy space or time and can be perceived by human beings through their sensory mechanisms.

The second classification is the percepts of movement. If an individual observes a boy running, he can perceive the boy, a thing, but he also perceives the movement of the boy through space. The light rays emitted from the stimulus would come from successively different positions as he moves. Movement can also be detected by means of sounds, and, therefore, the perception of the percepts of movement is not restricted to the visual modality.

There is a third type of percept which we have named change. If an individual perceives a thing on two separate occasions, he may notice (perceive) differences between the first and second percept. In perceiving change he notes that a neighbor's complexion has changed during a six-week absence, that an automobile suddenly does not operate as smoothly indicating the possibility of a flat tire, or that the outdoor temperature on Tuesday morning is cooler than it was on Monday morning. These are percepts of change. They differ from the percepts of movement in that the perception of movement is continuous for a time whereas the perception of change is discrete and requires at least two percepts of the "same" substance separated by time.

A fourth type of percept would be in the world of ideas. This suggests that a reader must perceive ideas before comprehending them (or, perhaps, before not comprehending them). There are obviously many kinds of ideas that a child must learn to perceive as he grows toward adulthood. The perception of main ideas and supporting details, of the organization of an argument, of the kinds of reasoning employed, and of the kinds of errors in reasoning that an author made are examples of the kinds of ideas that readers must learn to perceive.

A fifth type of percept is in relation to the perception of self. A similar and sixth classification of percepts would deal with the perception of others. There are many percepts that one can perceive about self which he cannot perceive about others. And there are many percepts that one can perceive about others that he cannot perceive about self. Percepts here would be those such as fatigue level, motives, affective states, comfort or discomfort, pleasure, or pain. Humans do, of course, extend many of these percepts to animal life as well as to other human beings. They may describe a cardinal as a robber because of the black patch around its eyes; they ascribe to monkeys sadness, humor, etc.

In the present study, perception training is considered only in relation to "things," "movement," and "change" involving the use of the visual receptors.

The Character of the Percept: Percepts, like the "objects" to which they are closely related, have characteristics that appear to be regular, that is, not subject to change. These are position, frame, quality, pattern, and constancy.

All percepts are within a field. Experimentally, the field or frame can be changed by withholding cues, and errors of perception will occur. Humans are aware (perceive) of space, sounds, and time fields but must use other phenomena to be aware of magnetic fields and almost always of atmospheric pressure fields. Thus, ideas are perceived within knowledge fields. "Wherever" the percept "lies" within the field is its defined position. The remainder of the field constitutes the frame. Some of the earliest experiments in figure-ground reversals (some still of interest) were built by under-cueing the field so that the perceiver could not differentiate the percept and the remainder of the field. Today many educators recognize impaired children who have difficulty in differentiating figure from ground. Smith and Smith (1962, p. 322) hold that detector cells are the responsible agents in the perception of position and motion, suggesting that damage to the cells would disturb normal perception of position, frame, and so on.

The characteristics of quality and of pattern are seldom misinterpreted by students of perception. Determination of quality of things usually does not present a problem; however, when a perceiver is required to perceive a thing through a picture of it, quality may be distorted since the perceiver perceives the picture rather than whatever the picture represents. The perception of the quality of ideas, self, and others becomes difficult unless the perceiver learns to define parameters or sturcture. Quality, then, refers to dimension, size, weight, importance, pitch, volume, color, line, and timbre of the percept. Pattern is similarly a characteristic. It involves shape, form, order, sequence, configuration, melody, organization, etc.

Constancy suggests that a percept is always the same regardless of the angle or distance, within limits. Thus, people on the sidewalk below look full-sized when viewed from the 2nd or 3rd floor window, but ant-sized when viewed from the 33rd floor window. The point of change should be of interest to some investigators. This distance limit is not yet well researched.

Many exercises have been published that purport to improve perceptual skill. They utilize activities based on frame, pattern, quality, and constancy, implying that these characteristics of the percept are trainable. While such exercises may well be of value, the explanation is in question. It is more likely, however, that the activity of the perceiver is changed through the use of these exercises and not the character of the percept. If Smith and Smith (1962, 322) are followed in theory the character of the percept would be distorted if the cells are incapacitated or were somehow prevented from functioning, as through failure to connect the appropriate cell assemblies or through inadequate metabolism. However, if the activity of the perceiver were changed through learning, the explanation could be based on selection of different and more appropriate cells and/or cell assemblies for the perceptual activity. This is Heukelman's (1964) point of view in the Neurological Impress Method.

The Activity of the Perceiver: In the preceding section, the relationship between the proximal percept and the object perceived in terms of position, frame, quality, pattern, and constancy was stressed. The dependence of the percept upon the object was pointed out and the resultant regular character of the percept was indicated. Differences in perception among individuals and the differences among perception skills of the same individual at varying points in time cannot be accounted for through consideration of the percept. However, they can be accounted for in the activities of the perceiver. These include input coordination, awareness, selection of essentials, discrimination, veridicality, retention, recognition, speed, and apperception. Each of these nine requires some explanation.

1. Input Coordination: Recent studies (Birch and Belmont, 1965; Stevitt and Rudnick, 1966) have considered the ability of children to coordinate visual with auditory input. When the number of visual impluses that a human brain can process in a single second is considered, the task of coordinating visual input alone seems staggering. Getman (1962, 1965) has suggested that the vision act of an adult is the result of previous experiences and learnings and that early learnings are the result of the coordination of the input of many sensory modalities, including kinesthetic and tactile.

2. Awareness: If he is to perceive, the perceiver must direct his attention toward the "object" to be perceived. This awareness may be part of a conscious process or it may occur without conscious awareness. Thus children, at the early stages in learning to read, must be made aware of the words, letters and the specific word parts that assist them to perceive word form. Initially, they struggle to perceive words. As they mature in reading skill, word perception

errors lessen until eventually the child becomes aware of words without being consciously aware of them. The perceiver must be aware (even though not consciously aware) of the "object" in his environment if he is to direct perception toward it.

3. Selection of Essentials: The good cartographer is selective in what he places on the map. The good perceiver is selective in the detail that he perceives. The cartographer creates a map with information useful to his potential readers. The perceiver selects detail in terms of the use to be made of the percept. The poor perceiver att tends to non-essential and extraneous detail. Skill in attending to the necessary details while perceiving (and ignoring the non-essential) is one of the activities of the perceiver.

4. Discrimination: Discrimination is the skill in discerning differences, in differentiating one event from another. In reading, discrimination skill is a highly important activity. In reading English, and probably in reading other languages as well, discriminations between very similar words are required (from-form, these-those, wish-wash, there-three, full-fell, etc.). The child at first very consciously makes the discrimination, but he eventually grows in the skill until discrimination is automatic.

5. Veridicality: Veridicality refers to the degree of correspondence between the percept and the object. The higher the degree of correspondence the higher the veridicality. It is doubtful that anyone is completely veridical in his perception. Very probably, the degree of veridicality achieved by a person is in proportion to training and opportunity to learn. Thus most of us in this country would have difficulty perceiving Japanese words, but little in perceiving English. We would have to "look" at Japanese many times to achieve even a modest degree of veridicality (to say nothing of awareness, selection of essentials and discrimination).

6. Retention: Retention is of two sorts, that is, memory of previous percepts and memory of present percept. Individuals who forget the first of a sentence before they can read the last may well have problems in retention of the percepts, current and/or previous. The process is probably one in which the current percept is compared with previous percepts until a "match" occurs, at which point recognition is attained.

7. Recognition: In its simplest form recognition is the matching of a current precept with a previous one, a kind of ah-ha or ah yes reaction. In reading, recognition usually also includes the naming of the word and the recognition of its meaning. Recognition as an activity of a perceiver occurs in all other areas too.

8. Speed: Perception occurs at a rate that varies from person to person and from time to time for a person. It appears to increase with practice in a substance (as in perception while reading).

9. Apperception: Apperception refers to the fact that whatever is perceived has significance or meaning. It may be considered as the bridge between perception and comprehension and understanding. English and English (1958) define it as the final stage of perception involving the matching with existing knowledge. Above matching is considered to be recognition.

If all nine activities of the perceiver occur regarding each characteristic of the percept for each kind of percept, a minimum of 270 different kinds of perceptual acts would occur. (See Fig. 1) Since we cannot preclude the existence of other kinds of percepts, of other characteristics, nor of other activities of the perceiver. And since we may not deny the possibility of sub-classes within any or all of the 20 items described above, we are forced toward (a) the belief that 270 is a minimal estimate and (b) the conclusion that the structure of perception is highly complicated.

In some of the preceding nine activities of the perceiver, level of activity was mentioned. Bateman (1965) points out that the mediating activities between input and output occur at various levels depending upon the skill of the communicator. In describing the process of three possible levels. We would, here, concur with Bateman's position and point out that the skill of the perceiver in each of the nine activities can vary from most inadequate to highly automatic. In fact, it would seem that it is in these activities that perception training would be most fruitful. Exercises in form perception or identification of hidden figures may serve to help children to grow perceptually only because they provide opportunity for practice in input coordination, awareness, selection of essentials, discrimination, veridicality, retention, recognition, speed and appreception.

To return momentarily to the definition of the Professors English (1958), their "primarily controlled by excitation of sensory receptors" is roughly equivalent to characteristic of the percept and their "influenced to a lesser degree by factors within the person" to activities of the perceiver.

Visual Perception and Vision Training

Since the present study is concerned with vision training and learning to read, the question regarding how vision training and perception are linked is most logical. English

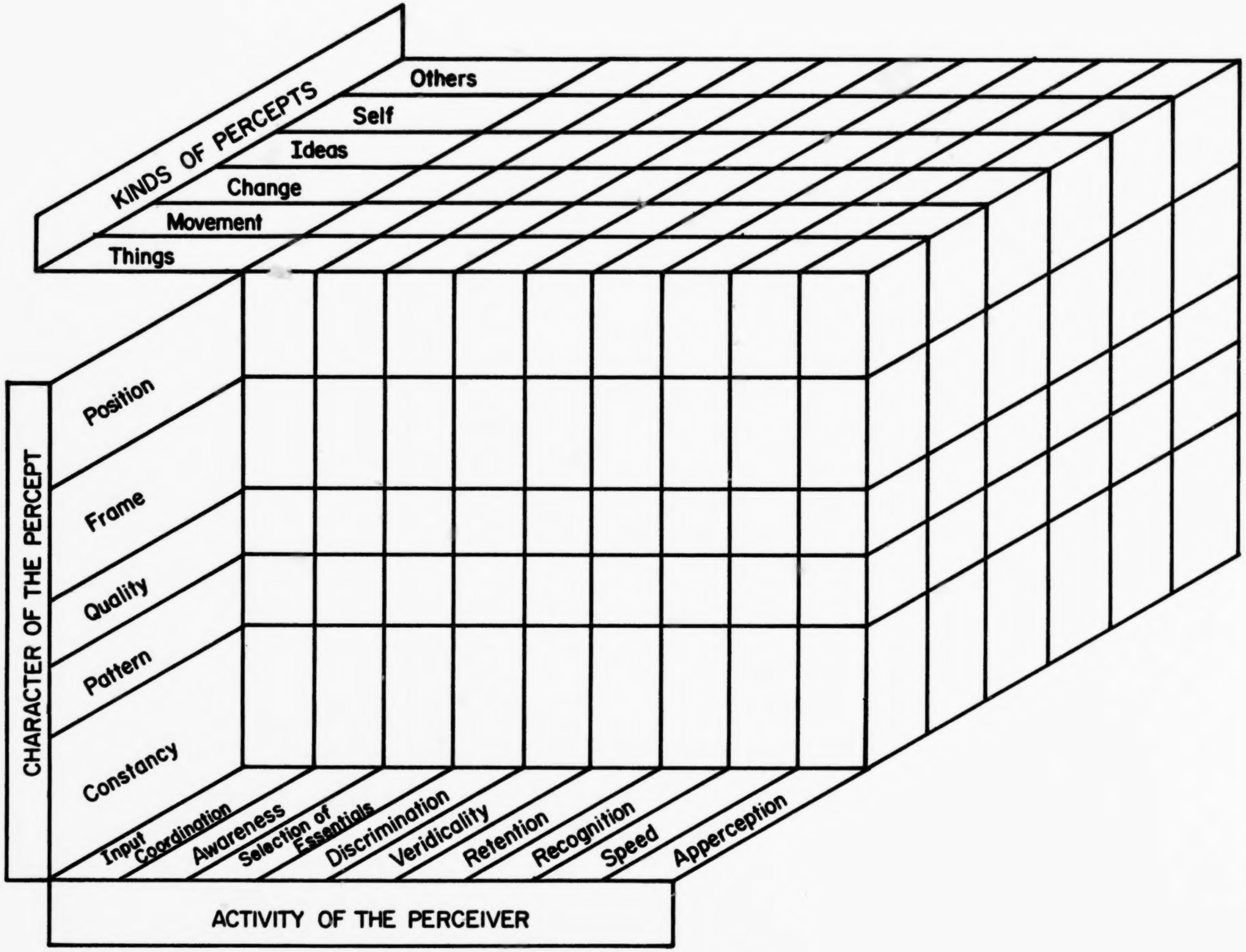
KINDS OF PERCEPTS
Others
Self
Ideas
Change
Movement
Things
CHARACTER OF THE PERCEPT
Position
Frame
Quality
Pattern
Constancy
ACTIVITY OF THE PERCEIVER
Input
Coordination
Awareness
Selection of Essentials
Discrimination
Veridicality
Retention
Recognition
Speed
Apperception

Fig. 1 - A three-dimension model of perception

and English (1958) tend to avoid the topic. They neither define visual perception nor vision training, although they do define orthoptics, a precursor to vision training.

The first question here is: What is meant by visual perception? Users of the term probably mean perception during which the rods or cones in the retina of the eye are (or have been) stimulated. It is doubtful that visual perception can occur with the exclusive use of visual receptors. In differentiating visual perception from auditory perception, we should consider the relative importance of the visual and auditory receptors in effecting the percent. We have noted that many people who are trying to locate the sound source while listening to stereo tapes will turn to look for the source and that some will seek kinesthetic reinforcement through finger, hand, or arm movement. Observations such as these point toward the conclusion that sensory mechanisms reinforce one another, that perception is paramount, and that the sensory mechanisms (visual, auditory, gustatory, etc.) are seldom, if ever, used in isolation.

If visual perception is perception effected in part through the visual sensory mechanism, then vision training becomes one way in which visual perception habits are changed. Modern vision training is directed toward changing habits of visual perception and must, therefore, be directed toward helping the seeing person to become a more effective and efficient perceiver. Modern vision training has its origins historically in orthoptics, a word which still carries the connotation of eye muscle exercises.

Kavner (1967) describes vision training as incorporating three different procedures:

1. Orthoptics: that phase of training which is devoted to the treatment of strabismus.
2. Pleoptics: that phase of training which is devoted to the treatment of amblyopia, especially when it is complicated by an eccentric fixation.
3. Developmental Vision Training: that phase of training devoted to the care of patients with visual motor immaturity.

Bernstein (1968) on the other hand provides four classes when he states:

> VISION TRAINING is the preferred general term which includes ORTHOPTICS, as applied to straightening the eyes in strabismus; PLEOPTICS, as applied to developing central fixation and macular and foveal function in amblyopia; GENERAL SKILLS TRAINING, as applied to developing visual abilities of a non-strabismic; DEVELOPMENTAL TRAINING, as applied to improving immature or retarded visual function.

In discussing vision and dyslexia, Flax (1968) discusses vision training as follows:

> The treatment procedure that have evolved from consideration of perceptual as well as mechanical factors in vision go beyond correction of refractive error and the type of orthoptic training utilized for strabismus and amblyopia. Training procedures emphasize ocular motility skills to permit accurate aiming of the eyes in concern with overt body movement and also independent of such supportive movement. Since postural and vestibular information play an important part in establishment of visual direction, balance and gross motor activities are incorporated into the treatment program as a means of developing the body coordinate schema, or body image, necessary to assign accurate spacial directions to data received by the eyes. Integration of tactile, propreoceptive, vestibular, and auditory cues is fostered to gain inter-sensory equivalence and the ability to transfer from one sense modality to another. Particular attention is paid to eye-hand coordination.
>
> While inter-sensory equivalence is necessary for efficient visual function, persistent need for redundacy via other sensory systems renders vision less efficient and particularly interferes with an abstract activity such as reading. Thus an optometric training program for visual perception also stresses the independent utilization of the visual system without the need for simultaneous support from other modalities. Initially, integration is stressed to permit structuring of eye input information, then as the fundamental structure becomes established, the emphasis is shifted to development of ability to maintain accuracy of visual perception without the need for immediate tactual, kinesthetic, vestibular or other sensory motor reinforcement.
>
> This type of training for visual problems has been utilized by some optometric clinicians for more than thirty years. They were not concerned specifically with the problem of dyslexia, but rather with the integrity and efficiency of visual function. Visual perception, while not singled out, was inherent in their definition of vision. Semantic confusion has obscured some of the significance of this early work and delayed its more widespread application and acceptance by psychologists and educators since the optometrists were saying "vision" while discussing "visual perception" and the educators and psychologists were equating "vision" solely with end organ receptor problems. Thus many workers in the field while denying vision as a factor in dyslexia (as they must according to their definition of vision), have recognized impaired visual perception as a part of dyslexia. The use of the term "word-blind" would imply visual involvement.

Macdonald (1968) in a paper overviewing the history of Vision Training, documents the point that vision cannot be explained completely by the physical laws applied to light rays and by forces or muscle power. He stressed (1) that although accommodation should vary only in response to the external (for example, as a target is moved closer), it also responds to the internal (as while problem solving); (2) that the weakest external eye muscle is 50 to 100 times stronger than it needs to be to move the eyeball; and (3) that some strabismic patients continued as strabismics even after developing very adequate adductive capacities. Macdonald believes that each person (1) learns to organize his own vision space world, (2) expands vision space world by growing in ability to process vision information which enhances ability to perform in space, and (3) develops deviencies (skewed information processing) as an adaptation to external or internal demands, Vision Training, for Macdonald, is the processuused to assist the person to learn adequate processing of vision information, thus providing greater freedom to perform within the vision space world.

G. N. Getman lectures and writes for optometrists as well as for parents and teachers. In his volume, The Physiology of Readiness, (1964) he outlines an elementary visual-motor-perceptual instructional program intended for all children. The program includes general coordination (e.g., head roll, hand lift, bilateral arm and leg movements, rolling, hopping, skipping), balance (e.g., walking beam activities forward and backward with forward and peripheral targets), eye-hand coordination (e.g., bilateral circles and lines at the blackboard and follow-the-dots "puzzles"), eye movements (e.g., finger jumps and pursuit movements), form perception (e.g., using chalkboard and desk templets), and visual memory (utilizing tachistoscopic presentation of simple to complex geometric forms).

Vision training as practiced by an optometrist may include any of the types of activities recommended by Getman. There would be several differences, however. The program would be based upon a thorough vision analysis, including diagnosis of visual perception skills. The vision training program would be individualized to meet the child's particular strengths and weaknesses. Some vision training practitioners also request "home" training, carried out under supervison of parents.

In a 1946 unpublished paper, the investigator described his own vision training program as including pursuit fixations, saccadic fixations, accommodative reserves, fusion, cheiroscopy, and tachistoscopy.

Modern vision training is described by Bernstein (1968). He states that there are five kinds of visual conditions indicating vision training: cosmetic, acuity, comfort, achievement, and prevention. He would direct training toward pursuit and saccadic fixations; eye-hand coordination; perception of form, size, and space; figure-ground discrimination; memory; visualization abilities; fusion; accommodation abilities; convergence; bilateral movement; and systems matching.

Kavner (1967) organizes two types of programs. One involves developmental procedures similar to those outlined by Getman above. The other uses the following schema:

1. Monocular procedures
    - a. Pursuits
    - b. Saccadics
    - c. Accommodative rock
    - d. Resolution
2. Transfer procedures
    - a. Unfused procedures
    - b. Lustre
    - c. Cheiroscopic procedures
3. Integration procedures
    - a. Fusion - ranges
    - b. Stereopsis
4. Hand-eye coordination

In the present study, each optometrist was responsible for the diagnosis and vision training of his own patient. There were, therefore, some variations from the above models; however, the intent as described above was general among the optometrists doing the vision training. Vision training sequences, as used in this study, are outlined in Appendix F.

Review of Related Research

This review provides a brief background from which an understanding of the need for the study can be achieved. It is organized in three parts: a review of summaries of research, a review of the research into vision and reading achievement, and a review of research into vision training and scholastic achievement.

Summaries of research: Surveys of the research on the relationship of vision and larning to read have been written by Bing, Eames, Harris, and Mangrum. Bing (1951) considered studies of such factors as visual acuity, refractive error, binocular coordination, fusion and eye dominance. She concluded that vision defects may be one factor contributing to reading disability.

Eames (1959) reviewed much of his own research. He organized the research into the following headings: Maturation, Amblyopia, Hypermetropia, Myopia, Astigmatism, Anisometropia, Esophoria, Hyperphoria, Exophoria, Strabismus, Visual Fields (including blind spots), Perceptual Speed, Lateral Dominance and Eye Diseases. He concluded that most of these disorders in some way contribute to success or failure in learning to read. He gave no consideration to vision training as a means of preventing failure or enhancing the success of the learner.

Harris (1961) considered visual factors to be sensation, binocularity, and perception. Regarding the relationship between vision and reading, he states that the significant factors are usually those of binocular coordination and that we know much too little about perception.

Mangrum (1967) organizes his review under the following headings: studies suggesting a relationship between visual defects and reading ability, studies suggesting no relationship between visual defects and reading ability, studies with corollary significance, and reviews of research related to vision and reading. He concludes that visual defects in terms of the number of children affected increase with years in school or chronological age. Further on he states, "visual defects may not cause reading disabilities per se but may impede reading development" (p. 18). He feels that individual differences may account for the fact that some children compensate for stresses and strains occasioned by visual defects and succeed while others fail. He strongly urges complete visual examinations for children and the provision of appropriate correction or training. He further suggests that early identification is important since visual defects may be more potent at early grade levels than at later grade levels

Studies of vision and reading achievement: Robinson (1946) pointed up the belief that inadequate vision skills are a cause of failure in learning to read and found it to be a cause in 50% of the cases she studied. Park and Burri (1943) reported a high correlation coefficient (r= .465) between the number of vision abnormalities and lack of reading success, implying strongly that the absence of vision defects was concurrent with success in learning to read.

Since then, much attention has been directed toward defining the aspects of vision in terms of how they operate to cause reading deficiency or success. Kephart (1957) showed that vision correction (glasses) of an experimental group resulted in greater gain in learning to read than that of the non-corrected control group. Robinson and Huelsman (1953) pointed out the possibility of the association of near acuity, depth perception, and other binocular functions with learning to read. Haines (1955) reported a seven-year longitudinal study carried out with the assistance of Wilda Rosebrook and Thelma Tyler. He stated that 11 of 37 children had normal vision throughout the period, that 16 had vision problems throughout the study, and that esophoria at near point (the tendency of the eyes toward crossing when no fusion is present) is a danger signal for vision and reading problems. In this study Haines has exemplified the use to be made of thorough case study information and the desirability of longitudinal studies of vision and of vision and learning.

After reviewing the literature, Hirsch (1955) concluded, "...it should be clear that certain of the visual anomalies are decidedly related to learning and can impair the child's learning. Some of these anomalies interfere with the child's ability to learn to read, others with his ability to clearly see material presented on the blackboard and projection screen."

Studies of vision training and school achievement: That vision training bears a positive effect upon school achievement has been concluded by several writers. Nugent and Ilg (1941) stated that children who had vision training learned to read more readily. Their evidence was sketchy, however. Twelve years later Eberl (1953) stated that children are being helped to be better students through vision training or glasses or both. Eberl and Nugent and Ilg have based their opinions upon case s study information obtained from their own cases. Other optometrists have indicated similar observations to the present investigator in conversations. Most of them contend that vision training helps the child to be ready to learn to read and have cases in their files that illustrate the contention.

The earliest references to perceptual training that we have been able to locate are those of Catherine Aiken in 1896 and 1899. Her results were considered extraordinary and challenging and her experiments were repeated by G. M. Whipple (1910) and W. S. Foster (1911) using college students. Dallenbach (1914) repeated the Aiken studies later. He concurred with Miss Aiken that perceptual activities enhance the capacities of children to perform in school and resulted in higher grades given by teachers. Whipple and Foster found no similar transfer among adults.

Studies using vision training with college students have been carried on by Apperson, (1940) Peters, and Olsen, Mitchell, and Westburg. The Peters' study (1939, 1942) was also reported by Worchester (1940). He depended mainly on the tachistoscope as a perception training technique. Mitchell (1964) also used the tachistoscope and recorded reading improvement which he explained as Hawthorne effect. Olsen, Mitchell, and Westberg (1953) on the other hand, used the Arneson Korector, the Keystone Telebinocular (both with a card holder and with an Ortho-Trainer Head), the Keystone Correct-Eye Scope, the Keystone Overhead Projector with Flashmeter Attachment, the Keystone Tele-Rotor Control, and the S. R. A. Reading Accelerator. Gains were primarily in terms of rate of reading. Cox and Hambly (1961) provided training in terms of the perception of direction, form, and distance. They selected 126 children in grades one and two whose achievement quotients were below .95 and who had failed one or more of five tests of visual perceptual motor skills. They suggest that the pupils who improve their performance on cheiroscopic drawing, stereopsis, or near point of convergence also improved their IQ's significantly, at the five per cent level of confidence. From their studies it is apparent that the control of vision training differed to such a degree from study to study that there was no agreement on definition.

Chansky (1963) used a Blockville Set #103 in ten weekly sessions of 30 to 45 minutes to improve perceptual skill. He found significant improvement in children who received perceptual training but no remedial treatment and in children who received perceptual training when their IQ's were high. He concludes that perceptual training may be a promising technique in rehabilitating elementary level underachievers.

Rosen (1966) used the Frostig materials as an implicit definition of perceptual training. He found no differences in achievement between his 12 experimental classrooms and 13 control classrooms. However, there was an improvement in perceptual skills. Low-perceiving experimental boys grew more than their controls.

Cohen (1966) also studied the effects of the use of the Frostig materials. Her test of perception was the Winterhaven Perceptual Forms Test. Test scores indicated that both control and experimental subjects made gains but that the experimental groups were significantly higher than the control groups in perceptual skills. She found no evidence that there was a corollary improvement in reading achievement.

The studies referred to above have used a variety of approaches to visual perception training. The studies were designed to use the same training procedures with each subject. A number of studies have been reported in which the discrimination pre-training utilized words and word form.

Muehl (1961) used 60 children from three kindergartens to determine the stimuli relevant to visual discrimination. He found that children taught to discriminate letters were better discriminators than those taught to discriminate words. There was, however, no difference in reading achievement among the three groups, a Duncan multiple range test indicated a significant difference favoring discrimination pre-training on words rather than on the letters that made up the words or no discrimination training. They concluded that words function as unique and unitary stimuli in discrimination training.

Gorelick's (1965) results confound the issue since her abstract symbol group made better word recognition gains than her meaningful symbol group, but no better gains than the controlled group, which received no perceptual training. These studies indicate that perceptual pre-training may be effective in assisting children in learning to recognize words. The confounding aspects of the various conclusions from these studies may be due to the fact that the instructional programs were fixed and not individualized to the unique requirements of the specific child.

The work of Lyons and Lyons (1954, 1956), on the other hand, involves the use of highly individualized vision training programs. They interpret the evidence, increased scores on the Primary Mental Abilities test, as indicating a possible shift from potential intelligence to usable intelligence.

Morgan (1966), in a master's thesis, reprinted and distributed by the Optometric Extension Program in 1968, provided individualized vision training for 40 children using three optometrists and compared the results with a matched control group of 40 children. The ages of the subjects are not indicated nor were the subjects and methods completely described. She found differences in favor of the experimental group at the five per cent or better level in ten different aspects: headaches, likes self, improved reading comprehension, socially aggressive, improved speech patterns, visual sequence--5 digits, misperception of rotated latters, hand-eye coordination, increased sports participation, and and increased scholastic performance. Apparently, these case records were collected over a nine-year period from 1955 to 1964. Morgan's results may have had more impact had differences between means and analysis of variance been used instead of Chi Square.

While not all of these studies were available at the time the present study was begun, they are cited here in an effort to show the framework of thinking under which the study was conducted and the frame work under which the results must be interpreted. It would be well if the present study could reject or confirm the findings as suggested by Morgan since her study and the one proposed are similar. At the time the present study was proposed it appeared important to discover whether children actually improved in terms of vision skills as the result of vision training and whether such improvement would influence their ability to read.

Several years ago Huelsman (1958) reviewed the conflicting evidence in recent studies of vision and learning to read. In a later study (1961 (1961) he reported the recommendations of a group of optometrists regarding needed research into the relationship between vision and learning to read. The currently proposed study is one of the two studies most frequently recommended by his correspondents.

Questions of the Present Study

The present study is directed toward (1) whether vision training results in improved vision skills and (2) the influence of improved vision skills upon the ability of elementary school children to learn to read.

More specifically it asks nine questions:

1. What is the incidence of reading disability among fourth grade children as measured by group test scores?

2. Do individual assessments of intelligence and reading achievement confirm group test predictions of reading disability?

3. What is the incidence of vision training referrals in a population of disabled readers?

4. What is the prediction of reading disability by the Bender Visual Motor Gestalt Test?

5. Do disabled readers show differing performance on a test of reversed copying of diagonal forms?

6. Is there a relationship between vision training and changes in reading achievement?

7. Do successive vision analyses reveal differences between the experimental and control groups?

8. Does intellectual capacity change as a result of vision training or remedial reading?

9. Are Ss in the study representative of the population of patients seen in the office practices of vision training specialists?

CHAPTER II. PROCEDURE

Selection of Centers

The project began with the selection of cooperating optometrists. A committee of optometric consultants selected 81 optometrists in private practice who were known for their vision training work with children. Each of these 81 received letters briefly describing the research procedure and asking them to participate by providing (1) vision analyses for several potential subjects from their respective communities; (2) vision training for one experimental child; and (3) three additional vision analyses over a three year period for both the experimental (vision training) child and one control child.

The 81 optometrists invited to participate were located in various parts of the country, although most who agreed to cooperate were located in the Northeast. Each optometrist's locale was considered a center, and centers ranged from Virginia to Indiana to Connecticut.

Fifty-one optometrists agreed to participate in the study, and sent in names of schools and school officials in their respective communities. For the 51 optometrists, 134 school officials were initially invited to participate. A school's involvement entailed (1) sending in lists of all fourth grade children with group test IQ scores and reading achievement scores; (2) referring psychologists who would arrange initial psychological testing for approximately ten children, as well as a series of 3 psychological evaluations over a three-year period; and (3) referring remedial tutors who would arrange for remedial reading for experimental and control children. It was intended that, insofar as possible, remedial tutoring and psychological testing should be in the context of school routines.

During this same period of time, the optometric consultants wrote a vision examination manual and a vision training manual, for use by cooperating optometrists. The attempt was made to develop a complete battery of vision tests that would be sensitive to vision skills subject to vision training. It was expected that systematizing vision skill testing would not only provide a standard for comparing Ss, but would suggest some predictor variables of response to vision training. Each cooperating optometrist whose community school official agreed to cooperate, received a copy of this manual and a kit of supplemental vision testing materials that included test forms and extra equipment for testing. Workshops were held for cooperating optometrists during the Spring of 1963.

Several school officials responded by stating that they would like to coöperate but that the request came too late in the year (April-May, 1963) to schedule psychological testing. At that point, the contract was amended by an extension of one year. The following year, 1964, a second group of fourth graders' scores was reviewed and a second group of children was selected (Group II) for the same experimental procedure. The same amendment changed the criterion of reading disability from a difference of reading achievement one and one-half years below mental age to reading achievement one year below mental age. This change in criterion for disability was made because the first few sets of group test data revealed that less than one percent of the children were disabled by one and one-half years, when scores from school-administered group tests were used.

The following is a report of the research procedure for Groups I and II combined. Table 4.1 is an outline of research procedures as outlined in the original proposal. The actual procedure for the major study and the selection and attrition data are summarized in Table 2. In all, 144 school officials were requested to cooperate with the project and responses were received from 60 or 41.7%. Thirty-three (or 22.9% of those contacted, school officials agreed to participate. Most of the remaining persons contacted did not respond to the letter, although 27 wrote to say that they could not or would not take part in the research. Reasons given for not participating included limited service resourced, disinterest in research, and reluctance to be involved with research associated with professional differences. The limited interest shown by public schools in participating in this kind of research was quite surprising. This issue is discussed in another chapter. At this point there were 30 active centers in the project.

Selection of Sample

Fourth grade level children were selected for two reasons: (1) by this level, the children have had ample opportunity to learn or not learn to read via the usual school routines; and (2) the vision demands at this level are great enough that vision difficulties will show up to a greater degree than at lower levels where demand for sustained vision performance is less.

The particular tests used in the psychological test battery were selected either because of (1) relatively high validity and reliability estimates, or (2) research interests in development of the tests. The Wechsler Intelligence Scale for children, and the Gates Reading Survey tests were used as criterion measures of intelligence and reading achievement level respectively. These measures are in general use and are widely accepted as reliable and valid instruments. Individual administration of each test allowed for observation of the child's motivation and investment in the test-taking task. Mental Age scores were calculated from WISC Full-Scale IQ Scores and Reading Age was obtained from the Gates Reading Survey. When a child was reading below the third grade level, the Gates Advanced Primary test was used.

The Draw-A-Person was included as a gross measure of emotional stability. Form 11 and the Bender were not used diagnostically, nor as bases for inclusion or exclusion in the study. Bender and Form 11 scores were examined for validity in predicting reading disability. Scores from both tests were also examined in defining differences between the experimental and control groups.

Group test scores for 10,071 fourth graders were reviewed and 444 children were selected for individual psychological testing. (Some of the school systems that sent copies of group test scores, had no fourth grade children with IQ scores above 85 who were reading one or more years below mental age level by those group test scores.) Each of these children was judged to be a potential disabled reader on the basis of one or more years' difference between mental age and achievement group test schores and each obtained a group IQ test score of above 85. The 444 children selected for individual testing were randomly assigned to experimental and control groups. All of these 444 children were referred for psychological evaluations by psychologists considered professionally qualified by their respective school officials, and app pointed by the Ohio State University Research Foundation. Those psychologists not employed regularly by the schools were paid from project funds for their services. Fourteen children (from Group I) of the 444 referrals were not evaluated because school psychologists in their respective schools did not have enough time to schedule examinations. Three children were already patients of optometrists cooperating with the project, and thus were ineligible as subjects. Five children were eliminated because the examining psychologists found evidence of emotional disturbance, bilingual background, or cultural disadvantage prior to testing. Any one of these factors, which are known to interfere with accurate estimates of intelligence, or reading achievement was judged to be sufficient reason for excluding a child as a potential subject.

These eliminations, and others which resulted from difficulties with scheduling and families moving to other communities, account for 65 potential subjects not evaluated by psychological testing.

Of the 379 individual psychological evaluations administered, 9 cases were eliminated because the psychologist, despite directions, did not administer the reading test. Of the 370 complete evaluations, 242 (or 65.4%) were found not to be disabled in reading by the criterion of reading one year below mental level. Sixteen children who did meet the disability criterion were eliminated for other reasons, such as bilingual backgrounds, medication, emotional or family disturbances and culturally disadvantaged homes. There were 112 children who were disabled in reading by one or more years.

The next step was to request parental permission for a vision analysis (VA) for those children who were disabled in reading and for whom there was no evidence of factors complicating assessment of intellectual achievement or visual skills. Parents of 112 children were requested to sign a permission skip and to contact the cooperating optometrists in their respective communities. At this point, there were 26 centers

TABLE 1

Diagram of Research Design From Original Proposal

Selection of Optometrists and Areas

Volunteer School Organizations

All Fourth Grade Children

Via School Administered Group Tests

All Children with RA 1 1/2+ Years Below MA

Via Sampling	Via Sampling
100 Children plus 100 Alternates	100 Children plus 100 Alternates
Via WISC & Gates	Via WISC & Gates
Intermediate Sample N = 100	Intermediate Sample N = 100
Via Vision Analysis	Via Vision Analysis
Final Sample N = 40 or more Experimental Group	Final Sample N = 40 or more Control Group
Vision Training	No Vision Training
2nd Vision Analysis and 2nd Psychological	2nd Vision Analysis and 2nd Psychological
Remedial Reading	Remedial Reading
3rd Vision Analysis and 3rd Psychological	3rd Vision Analysis and 3rd Psychological
Follow-up Vision Analysis and Psychological Evaluations (one year after 4th Vision Analysis and 4th Psychological)	Follow-up Vision Analysis and Psychological Evaluations (One year after 4th Vision Analysis and 4th Psychological)

TABLE 2

Selection and Attrition

Procedure and Explanation	Number of Ss Eliminated	Number of Potential SS
Group test scores		10,071
Selected for individual psychologicals		444
Not evaluated because of time	14	
Patients of optometrist	3	
No parents' permission for psychologicals	1	
Moved or unable to schedule	42	
Excluded prior to testing because of emotional disturbance (2), bilingual home (1), culturally disadvantaged (2)	5	
Individual psychological evaluations		379
Not disabled by 1 year criterion	242	
Disabled but excluded for other reasons: bilingual home (3), on medication (1), family or emotional disturbance (11), culturally disadvantaged (1), incomplete evaluation-no reading test (9)	25	
Disabled in reading and referred for vision analysis		112
No parents' permission for VA	43	
Permission given, but no contact with optometrist	1	
School withdrew	6	
Rejected on vision basis without VA	1	
Records lost in mail	1	
Vision analyses		60
Rejected on basis of VA (vision problem not subject to vision training or no vision problem)	20	
School withdrew	3	
Child's family moved from community	1	
Records missing or incomplete	4	
Selected as subjects (experimental and control)		32
Optometrist resigned because of illness	1	
Cases followed		31
Experimental case eliminated because originally assigned to control group	1	
Cases eliminated because of incomplete data	6	
Experimental cases randomly eliminated to equalize comparison groups	2	
Cases in final statistical analysis		22

still involved with the research.

Of the 112 sets of parents contacted, parents of 43 children did not grant permission for their children to have vision examinations. One set of parents granted permission, but failed to contact the optometrist, even with repeated requests and reminders from the central office. It seems important to note that while many of these cases were lost at this point because there was no response at all from parents, several parents refused because their children were already receiving regular vision care from a refractionist, and they saw no need for an evaluation by another vision specialist. One shcool system* withdrew from the project after its school board vetoed the superintendent's decision to cooperate. This withdrawal eliminated six potential subjects.

The parents of 62 children agreed to participate in the project and contacted their respective cooperating optometrists. One child was eliminated as a subject on the basis of vision without a complete examination, and another child's vision analysis records were lost in the mail. The remaining 60 children received complete vision analyses and their examination reports were duplicated for review by each member of the optometric consultants' committee. One child's family moved after the vision analysis was completed, and in four cases, vision analysis records were incomplete. Another center where three children received vision evaluations closed because of difficulty with one set of parents.** Thus, 52 cases remained as potential subjects.

Of the 52 complete vision analyses reviewed by the consultants' committee, 20 (or 38.5%) were rejected as subjects on the basis of no vision problem, vision problem not subject to vision training,*** or as not appropriate for vision training. The 32 cases considered eligible for vision training were re-assigned where necessary to experimental and control conditions to even the size of the groups.

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*North Hills Joint Schools in Pittsburgh, Pennsylvania, initially agreed to cooperate on the basis of the Superintendent's decision. In reviewing the decision, the school board decided that to cooperate with this research would be an endorsement of one profession (optometry) over a competing profession (opthalmology).

**Parma, Ohio, Public Schools withdrew because "we are not anxious to encourage criticism from our partents." One set of parents had asked for more complete information about the research and had pointed out that the family vision doctor did not recommend glasses when the project's training optometrist did recommend glasses.

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***Children having certain kinds of vision problems were excluded. These included refractive errors of more than 1.50 diopters (plus or minus) at far point or of more than one diopter of astigmatism and constant strabismics.

In summary, the final selected sample consisted of 32 fourth graders each of whom exhibited a Reading Age one or more years below his Mental Age and whose vision analysis was judged to indicate the need for vision training. Parental permission was requested and received in all 32 cases, for the child to remain under the vision care of the respective cooperating optometrist for the two year course of the study.

Course of the Study

All 32 cases were to be followed for three years as outlined in the proposal. The experimental cases received vision training, after which both experimental and control subjects received the same treatment of (1) second vision analyses and second psychological evaluations; (2) remedial reading instruction; (3) third vision analyses and psycho logical evaluations; and (4) several months later, fourth vision analyses and psychological evaluations. Vision analyses were standardized and reported on forms prepared early in the study by the optometric consultants' committee. The Manual of Procedure is in Appendix E and forms are in Appendix G. Each psychological evaluation consisted of the Wechsler Intelligence Scale for Children (WISC), the Gates Reading Survey, the Bender Gestalt, the Draw-A-Person, and Form 11, a copying test. Gates forms 1, 2, and 3 were alternated per testing session for each subject. The WISC protocols were carefully recorded. Williams (1966) used the errors in his thesis, an abstract of which is in Appendix C. Two vision tests were studied with separate populations by Braddom (1966) Dwight (1966), and Gisseau (1966). Abstracts of these studies are in Appendix C.

Children in the experimental group were scheduled for vision training as soon as parental permission was received. Vision training for each experimental case was individualized to meet the child's individual vision needs. The cooperating optometrists used the manual (Appendix F) prepared for them in selecting training procedures. Although training records for experimental cases were not always detailed records of office visits, vision activities, and home training were kept by the training optometrists. The second vision and psychological evaluations for both experimental and control cases followed vision training as closely as possible.

Remedial tutors were selected by the respective cooperating school systems, and in most cases, were regular remedial reading teachers in the schools. Tutors were informed about the study and given a brief summary of psychological evaluation data before instruction began. They were not informed, however, whether the children they tutored were experimental or control cases.

It was impossible, and probably inadvisable, to standardize remedial instruction. Some Ss were tutored individually and some were tutored in small classes. In all cases, the particular remedial techniques used were left to the judgment of the tutor. Tutors were requested to keep logs of their instruction, and were encouraged to provide at least 30 and no more than 40 sessions. Tutors held to this restriction except in cases where the child was already regularly enrolled in school remedial classes.

One training optometrist has to resign because of illness. The other 31 subjects were followed through the two year procedure, although in a few instances, not all the data were complete. For the final statistical analysis, several subjects were eliminated because of incomplete data. The final psychological examinations (follow-up) were missing for three subjects; three other subjects had incomplete data; one case was eliminated because he was initially assigned to the control group and had been treated as an experimental case by the cooperating optometrist. Finally, two more experimental cases were randomly eliminated to equalize the comparison groups. There were 22 cases in the final statistical analysis, of which 11 were experimental and 11 were control cases.

Differences from Original Proposal

The most striking difference between the study as proposed, and the procedures actually followed, is the difference in sample size. The smallest number of subjects allowed originally was 80; 100 or more were anticipated.

There was not a sufficient number of disabled readers available to allow for the pool of 400 potential subjects as anticipated in the proposal. As can be seen by comparing Tables 1 and 2 at each step in the selection procedure more potential Ss were lost than anticipated. Enough subjects were lost for reasons cited above to warrant a closer look at the rate of attrition and to compare it with attrition of patients in private vision training. This attrition study is reported in Chapter 3.

During the course of the study, it became increasingly difficult to coordinate by mail the efforts and schedules of parents, children, cooperating optometrists, psychologists, remedial reading teachers, and school officials. Consequently, while events such as vision training, remedial reading, and testing followed the same sequence as outlined in the original design, they did not always occur simultaneously for experimental and control cases. For example, if an experimental case in any one center began remedial tutoring, his matched control should have been tutored at the same time. If the control case had not yet received his second vision or psychological tests, or if his remedial reading teacher was unable to schedule him until later, it was impossible to keep him on the exact same schedule. Disparities such as this occurred very frequently between experimental-control matches and among both experimental and control groups because of heavy professional schedules, vacations, and a time lag in responding to inquiries.

One of the events that differed most from the original proposal is the follow-up study that was planned for one year after the termination of remedial reading. The fourth psychological and vision evaluations were administered from 4 months to 1 year after the third evaluations.

A considerable amount of data was collected during the four years duration of the study. Some of these data were analyzed independently, and some smaller scale studies were conducted supplementary to the data already accumulated. This auxiliary research is reported in Appendices B and D.

CHAPTER III FINDINGS

The findings are reported in terms of the questions recorded in Chapter I, and the evidence presented regarding each question is discussed. Some general interpretation is reserved for Chapter IV.

Question 1: What is the incidence of reading disability among fourth grade children as measured by group test scores? During the years 1963 and 1964, 30 school systems in 10 states reported the intelligence test and reading test scores of 10,071 fourth grade children. An examination of these scores indicated that 1026 of them were achieving at a level one year or more below capacity level. The number of disabled readers by group scores were not evenly distributed among the 30 schools. We requested individual tests of 444 of these children and succeeded in obtaining both intelligence and reading test scores for 370. The question under consideration here, however, is how many children at grade four are disabled readers. The answer appears to be about 10% (1026/10,071). Unfortunately, no answer can be quite this simple.

Discussion: In estimating the epidemiology of reading disability, several problems warrant attention. First; in the procedures chapter it was indicated that 144 school officials were asked to participate and that 33 (22.9%) agreed to do so. Only 30 of them supplied the information from which the evidence reported above was sscured. Therefore, ten percent as a figure may be accepted only insofar as the thirty schools reporting represent the population as a whole. The reluctance of 114 schools to participate in the research may have been based upon the reasons suggested in the previous chapter. Certainly bias against the optometric profession would not likely influence these findings; however, there are two other "unspoken" reasons that could bias the evidence: (1) if a superintendent knows that his system was relatively ineffective, he risks exposure in cooperating (or at least publicity that indicates the school has children who have not learned to read) and he, therefore, refuses; and (2) some school officials may fear knowing about systemic inadequacies. (Such knowledge disturbs the status quo. It would necessitate action.) One can conjecture that systems which refused to participate on the above grounds would likely have higher percentages of disabled readers and that, therefore, a 10% estimate of underachievers in reading probably is minimal.

A second problem is that of goal setting. At what level should a child achieve? There are some who would have the child set his own goals without any sort of guidance or encouragement. At the other extreme, there are still some who set chronological age goals and others who set mental age goals. While mental development is a large contributor to each child's growth in reading skill, it is not the sole contributor. Therefore, to set expectancy for achievement in terms of mental ability alone would be in error. One way to take other factors into account would be to modify an MA derived goal in terms of other variables, such as drive, experiential background, etc. Another way would be to assume that the statistic, Reading Age minus Mental Age, distributes along the normal curve and then to select those who fall one standard deviation or more below the mean. In the present study, we assumed a mean score of zero and a standard deviation of 1.0. In an unpublished study completed by the principal investigator in 1953, the author assumed a mean of zero and obtained standard deviations of 1.7 in grades 3, 4, and 5; and 1.8 in grades 6, 7, and 8. Currently, three sets of data are being considered in the hope for further clarification.

The third problem has to do with the measurement of mental ability and of reading achievement. The definition of reading changes as achievement level changes. Reading at grade one is not the same as reading at grade four. Furthermore, reading on one test is not the same as reading on a second or a third test. Unfortunately, the measurement of mental ability has the same two problems. It becomes most difficult, then, with the evidence at hand where different intelligence tests and reading tests have been used in the 30 schools, to say with any degree of certainty that 10 percent of the children in grade 4 are underachievers in reading. The answer depends in part upon the definitions of reading and intelligence implicit in the instruments used by the schools.

The fourth problem lies in the purpose for which the evidence is collected. In the present study, the investigators were concerned with identifying disabled readers in an objective manner. Most school systems and school faculties are equally concerned with identifying underachievers in an objective manner. It may well be, however, that the evidence used in this process must be unique to each school. Thus, tests for disability may differ; the capacity-achievement difference mean score and standard deviations may not be universal but unique to the local system or building.

Bond and Tinker (1967, p. 9) cite studies showing that from 8 to 25 percent of the children in school are having difficulty in learning to read. The studies show a trend toward 16 percent, a not surprising number when one considers that by definitions 16 percent of the area under the normal curve is below -1.0 standard deviation. Individual school systems in the present study varied in percentage of disabled readers from zero to 42. In one school the very cooperative teachers and principals tried for two years to produce one disabled reader and failed. We could only conclude that (1) the faculty was unusually expert in teaching reading, or (2) the disabled readers had transferred out of this private school into the nearby public school before grade four, or (3) the children were unusually motivated to learn and/or were exceptionally skilled in taking tests.

In the present study, the investigators have selected about 10 percent of the fourth grade population as disabled readers. They believe, however, that no such generalization should be made for all schools. It seems more appropriate for each school to study its own population of children, establish its own capacity-achievement mean score and standard deviation, and consider for remedial education those whose capacity-achievement difference scores are more than one standard deviation below the local mean score. The procedure would select 16 percent of the school population for consideration as potential disabled readers.

Question 2: Do individual assessments of intelligence and reading achievement confirm group test predictions of reading disability? If the 10 percent estimate of epidemiology used in the present study is an accurate estimate, then scores from individual tests administered to the children would show that all the children were disabled in reading. Some change because of regression toward the mean and some change because of the relative unreliability of the tests would be expected. However (as shown in Table 2), of the 370 children retested with WISC and Gates tests, only in 128 cases (34.6%) was the disability estimate of one or more years confirmed. In 16 of those 128 cases, there were factors operating that are known to interfere with accurate estimates of intelligence and achievement, e.g., bilingual homes, medication, etc. Thus in only 112 cases (30.3% of 370; or 31.4% of 354) were group test predictions validated by individually administered evaluations.

Discussion: The evidence gathered in the study strongly suggests the relative unreliability of school-administered test scores when used to identify underachievers in reading. Certainly one would expect the capacity-achievement difference to regress toward the mean upon retest. Certainly some change in capacity-achievement difference should result because the tests are not perfectly reliable. These two confounding factors, however, could not be expected to explain a 65% or more over-identification (false-positives). Furthermore, if the procedures used in the schools resulted in 65% false-positives, some false-negatives could be expected. Perhaps many children who are truly disabled in reading are overlooked.

If we look elsewhere for an explanation, we must look at (1) the instruments chosen for use in the schools and (2) the differences in the testing situations. Whenever group test scores are used to indicate reading disability, evidence regarding the validity and reliability of the tests is extremely important. Many of the group tests listed and reviewed by Buros (1965) in the Mental Measurements Yearbook have been shown to be unreliable and/or invalid, yet they continue to be used by schools and school systems for evaluation of childrens' performance and potential and for assessment of programs and curricula.

The individual testing situation differs from the group testing situation. The effort put forth by children when tested individually is often much greater than when they are tested in a group. It may be that children need to be more aware of score differences occurring partly through effort alone and the importance of decisions regarding them that will be made throughout their lives from test scores. Motivation to score may explain, in part, why there is a 65% or more over-referral.

The high percentage of over-referral evident from school tests, and the change in status with individual tests, implies the need for caution in generalizing from results of studies that portend to show reduction in capacity-achievement differences resulting from remedial instruction whenever initial tests are group tests and final tests are individual.

The conclusion seems inescapable, however, that school personnel should select group tests most carefully and that conclusions from them regarding deficits in reading achievement should be considered as indicative or as very rough approximations and not as absolutes.

Question 3: What is the incidence of vision training referrals in a population of disabled readers? During the conduct of the study, vision analysis records for 59 fourth grade children, known to be disabled in reading, were available for comparison. At the conclusion of the examination for each child, the optometrist placed the child in one of six categories:

1. No vision problem (1 child)
2. A vision problem unrelated to reading disability (8 children)
3. A vision problem related to reading disability but not subject to vision training. (5 children)
4. A vision problem related to reading disability but with additional complicating factors making training inadvisable. (6 children)
5. A vision problem related to reading retardation which should respond to vision training alone. (7 children)
6. A vision problem related to reading retardation which should respond to vision training combined with remedial reading. (32 children)

Of the 59 children examined, 39 (66%) were placed in one of the two categories indicating that they would profit from vision training. In most cases (N=32), the optometrist indicated that training and remedial tutoring should be combined.

Discussion: This is a small sample from which to generalize; however, the fact that only 66% were identified as likely to profit from vision training has significance. Certainly we can state that, in the clinical judgment of leaders of the optometric profession, not all disabled readers will profit from vision training. Furthermore, the information from the vision analyses and the reviews of these data by other optometrists strongly suggest consensus among vision training specialists on criteria for referral for vision training.

Question 4: What is the prediction of reading disability by the Bender Visual Motor Gestalt Test?

Findings I: The Koppitz (1964) mean scores and standard deviation of 101 disabled readers on the Bender were compared with the Koppitz' norming group of fourth graders. No statistically significant differences at a 5% level of confidence were found. Although the mean scores are 1.9 against 1.5 and the standard deviations 2.39 against 1.88, the differences do not approach significance. If Koppitz' norms are applied, 16% of the 101 Ss have significantly high scores. This is identical with the area under the normal curve beyond one standard deviation above the mean and is, therefore, the expected number. In all probability, the 101 underachievers are not different from Koppitz' fourth grade standardization group. (The 101 had complete WISC protocols; 11 did not.)

TABLE 3

Comparison of Bender scores of 101 underachievers with Koppitz' fourth grade norming group.

	Koppitz' Norms	Underachievers	Difference
Age	9-8	10-0	
Mean Score	1.5	1.9	.4 (NS)
Standard Deviation	1.88	2.39	Ratio 1.27 (NS)
N	39	101	
SE_m	.31	.24	.39

Discussion: There are several ways to interpret this finding. One could suggest that skill in performance ceases to grow at this age. More likely, however, the Bender, as scored by Koppitz, is not sensitive to growth at this age. A new and more difficult test of visual perception is needed to fill the gap at this level, to measure visual-motor skills at ages above 9 or 10.

Findings II: The Koppitz-Bender scores of the 22 children who make up the experimental and control groups of the current study are also of interest. In general, little change occurred over the two-to-three-year span except change with subsequent testing. The experimental group appears to have changed with vision training (between Test 1 and Test 2); and the control group with remedial reading (between Test 2 and Test 3); however, at the follow-up point (Test 4) the two groups are in the same relative positions as they were at Test 1, except that both appear to have improved.

TABLE 4

Koppitz-Bender scores for Ss in the study

	Individual Evaluations			
	1	2	3	4
Experimental (N=11)				
Mean	2.3	1.5	1.7	1.3
Standard Deviation	2.49	1.16	2.14	1.30
Control (N=11)				
Mean	1.6	3.1	1.3	0.8
Standard Deviation	2.27	3.03	0.86	1.47
Total Group (N=22)				
Mean	1.96	2.27	1.50	1.09
Standard Deviation	2.40	2.43	1.64	1.41

Discussion: Since the changes could be easily accounted for by growth and since the scores at no time appear to be markedly and significantly different from Koppitz' expectancies, no further analysis was attempted and no change in the conclusion above seems justified.

Findings III: Among the 370 children who received initial psychological and reading tests were 56 whose achievement in reading was two or more months above the level indicated by their mental age. The Bender scores for these 56 children were also examined. Their Koppitz scores are inferior to the scores of the Koppitz standardization groups at a relatively high level of confidence. Of the 56 children 14 have scores of 4 or higher. If the three high scores (11, 13, and 19) are discounted, however, the mean score is 2.1 and the standard deviation is 1.95.

TABLE 5

Comparison of Bender scores of 56 achievers with Koppitz fourth grade norming group.

	Koppitz' Norms	Achievers	Difference *t* or *F*
Age	9-8		
Mean Score	1.5	2.9	1.4 (1% level)
Standard Deviation	1.88	3.57	Ratio 1.9 (5% level)
N	39	56	
SE_m	.31	.48	

Discussion: The scores of three individuals account for the differences noted above. The direction of the different is, in general, contrary to the expected findings (i.e., children with poor Benders tend to be poor in reading). One should suggest that these three children have somehow learned to compensate for very inadequate visual motor skill and have learned to read well in spite of it. An alternative explanation could lie in failure of the Koppitz-Bender scores to be related to reading achievement at the levels represented by these data or that the relationship is non-parametric and only a minimum achievement is required to succeed in reading.

Question 5: Do disabled readers show differing performance on a test of reversed copying of diagonal forms? At the early stages of the study, the optometric consultants suggested that a drawing test be constructed for use in the study, one that would be more difficult than the Bender and would place greater emphasis on diagonal lines. Eight drawings were suggested. A normative study was conducted by the late Jean Aurand as a Master's Thesis (1964). A summary of the Aurand study and a copy of the Form 11 test are included in Appendix B.

The children were given eight figures and asked to copy them. They were then asked to copy them in a reversed form. In the Aurand study, all children were tested individually and timed on each part of the test. It did not appear that time was a substantially different score from number right, so the time as a score was dropped. Furthermore, children's scores for copying and reversed copying were not markedly different, and, therefore, the single score, number right, became the only score.

Scores on the test are not as consistently available as were scores on the Bender. The test was administered as a part of the vision examination in some centers and not all children given psychological examinations (in school) were given vision examinations (in the optometrist's office). Thus, 67 of the 101 underachievers, and 55 of the 56 achievers, and all 22 Ss of the study group were examined on Form 11. The mean scores of these groups were compared with Aurand's scores for fourth graders.

TABLE 6

Comparison of Form 11 scores of achievers, underachievers, study Ss, and Aurand's fourth grade norming group.

	Aurand's Norms	Underachievers	Achievers	Study
Mean	9.60	12.7	12.4	12.8
Standard Deviation	3.1	2.67	1.47	2.61
N	60	67	55	22
SD_m	.40	.52	.20	.57

The mean scores of the three groups appear to be different from Aurand's group of fourth graders. There are no significant differences among underachievers, achievers, and the study group. Similarly, the 55 achievers appear to be a less widely dispersed group than the other three. The _F_ ratios indicate variance differences between achievers on one hand and underachievers and the study group on the other to be statistically significant (_p_ .05). The difference between achievers and the Aurand norm group are significant at the .01 level of confidence.

Discussion: The difference observed here may well be accounted for by differences between Aurand's group and the children in the present study (for example, the norm group is about eight months younger and are probably more naive). There is another difference, however, that needs to be considered. Although the scorer used in the present study was trained and supervised, there may be differences between Aurand's scoring and that of the scorer in the present study. The fact that the three groups of the present study are so close together would tend to reinforce this notion. Furthermore, one would expect the differences to parallel the Koppitz-Bender scores rather than to reverse the trend. Since the Ss of the present study performed more adequately than the norming group on Form 11 and less adequately on the Bender, confounding factors other than real differences should be considered.

In view of the relatively low reliability of Form 11 indicated by Aurand (see Appendix B) and in view of probable scoring difficulty, it would seem that Form 11 has limited usefulness as a predictor of reading disability. Observation of the manner in which the child reverses his perceptual field may well have diagnostic meaning when combined with other observations and test scores in clinical situations. Its promising value for assessment of change during and following vision training is discussed in question seven below.

Question 6: Is there a relationship between vision training and changes in reading achievement? The reading test scores (Gates Reading Survey) and the Reading disability scores (each reading test age score minus MA when MA is extrapolated from Test 1) at the four psychological evaluation points in the study were subjected to a single analysis of variance. Vision training occurred between Test 1 and Test 2, remedial reading between Test 2 and Test 3, and a neutral period between Test 3 and Test 4. There were 11 children in the experimental group and 11 in the control group. In general, the analysis showed no differences between the experimental and control groups, although two changes over time were significant at the .05 level of confidence. That the Ss grew in reading skill is apparent from Table 7.2. It shows a gain in reading skill which does not differentiate between the control and experimental groups. A comparison of Tables 7.1 and 7.2 indicates that the growth in reading is significant over the entire period (Test 1 to Test 4) but is not significant between consecutive tests. That the Ss became more disabled is apparent from Table 7.4. It shows an increase in reading disability during the course of the study that again does not differentiate between the experimental and control groups. A comparison of Tables 7.3 and 7.4 indicates that the increase in reading disability is significant over the entire period and not between consecutive tests.

As conducted in the present study, neither the vision training nor the remedial reading instruction served to make any difference with the 22 children in reading disability. Although Ss developed somewhat in reading, there is no evidence in the present study that vision training is effective in changing reading achievement. While reading skills changed positively during the course of the study, reading disability increased. Since there is no control group with remedial reading as the experimental variable the observation is mandatory that while remedial reading failed to decrease capacity-achievement difference, its absence could have had different results, possibly, an even greater increase in capacity-achievement difference.

Discussion: The question now presents itself as to how far one may go in generalizing from this evidence. From such evidence as is available

TABLE 7.1

Analysis of Variance of Non-cumulative Reading Age Gain Between Test Dates

Source of Variance	Sum of Squares	df	Variance	F
Among Cells	1257.40	5		
Between Columns (1-2,2-3,3-4)	723.85	2	361.92	2.46 (NS)
Between Rows (E,C,)	32.06	1	32.06	.22 (NS)
Interaction	501.49	2	250.74	1.70 (NS)
Within	8834.36	60	147.24	
Total	10091.76	65		

TABLE 7.2

Analysis of Variance of Cumulative Reading Age Gain Between Test Dates

Source of Variance	Sum of Squares	df	Variance	F
Among Cells	1574.30	5		
Between Columns (1-2,1-3,1-4)	1240.21	2	620.10	4.46*
Between Rows (E, C)	47.52	1	47.52	.34 (NS)
Interaction	286.57	2	143.28	1.03 (NS)
Within	8337.64	60	138.96	
Total	9111.94	65		

* Significant at the .05 level of confidence; represents a gain in Reading Age across dates, and includes both experimental and control cases.

TABLE 7.3

Analysis of Variance of Non-cumulative Reading Age Gain Between Test Dates

Source of Variance	Sum of Squares	df	Variance	F
Among Cells	1701.76	5		
Between Columns (1-2,2-3,3-4)	1036.94	2	518.47	2.67 (NS)
Between Rows (E, C)	0.24	1	0.24	.001(NS)
Interaction	664.58	2	332.29	1.71 (NS)
Within	11652.18	60	194.20	
Total	13353.94	65		

TABLE 7.4

Analysis of Variance of Cumulative Reading Age Gain Between Test Dates

Source of Variance	Sum of Squares	df	Variance	F
Among Cells	1822.73	5		
Between Columns (1-2,2-3,3-4)	1458.73	2	729.36	3.22*
Between Rows (E, C)	129.82	1	129.82	.57 (NS)
Interaction	234.18	2	117.09	.52 (NS)
Within	13600.91	60	226.68	
Total	15423.64	65		

* Significant at the .05 level of confidence. Represents an increase in disability across dates and includes both experimental and control cases.

here, one can conclude neither that vision training is effective nor that it is not effective in assisting underachievers in reading. There are some points, however, that can and should be made.

A. Sampling problems have been discussed previously. They are confounding in any answer to this question. The 444 children selected to represent the disabled reader were reduced to 22. Even if the 22 had been randomly selected they would not be truly representative of the 444. It would be highly unlikely that some affective bias would not occur.

B. Several of the consulting optometrists have pointed out the lack of coordination between remedial reading instructors and vision training optometrists in the study. In some practices such coordination is considered vital to the progress of the child. Whether such coordination would have made a difference in the present study is a moot question; but the point should be considered in subsequent research. The consultants have also pointed out that the articulation of the steps in the project made it difficult with some children to provide enough training time.

C. While the 22 children grew in reading skill, they did not show statistically significant growth during the remedial reading period, nor did they show the expected change in relation to capacity. Since children in general do improve in reading when taught and in general do achieve at a level closer to capacity after remedial reading, the question of a biasing factor might be raised. There are two "points" where bias may have occurred in a fashion that is uncontrollable. The first was at the point where the parents were asked to permit their child to be examined visually and to be given remedial reading. Of the 112 sets of parents 60 gave permission. Some indicated that the child had no reading problem. Others indicated that their family doctors or pediatricians advised them not to cooperate. Others simply did not respond.

The second "point" for bias is in follow-through. Several Ss had to be dropped simply because they did not keep appointments for visual examinations despite several requests. Obviously, if we requested too often, a Hawthorne effect would be introduced. It is obvious that the opportunity for bias among the experimental and control subjects is such as to affect growth, possibly to the point where experimental-control differences could not be ascertained. If this study is ever redone (probably not before about 20 years), a much less complicated design should be proposed, using captive Ss such as might be available in a residential school setting that retains its population for a three or more year period.

D. In several instances experimental children were required to wear lenses for training purposes and in others to perform some vision training activities at home. The consultants pointed out that the case records showed that the Ss frequently failed to wear the lenses prescribed and to perform the home-assigned tasks. This situation may well have occurred because of the lack of parental involvement. In private practice, patients appear to be more involved and more motivated to carry out the requests of the vision training optometrists.

E. The consultants have also pointed out that the vision training task for children who have both vision training disabilities varies with the level of the learning-to-read task. There is a distinction here between vision while reading and vision while learning to read. The second involves a different (and possibly more intense) purpose and therefore a different visual set (L. D. Macdonald, 1963). Thus, generally, vision training of disabled readers achieving at grade one is more likely to involve visual form perception, constancy, and the like, whereas vision training for disabled readers achieving at the seventh or eighth grade level is more likely to involve speed. In the present study of fourth grade children achieving at levels generally from mid-second to mid-third grade, one may expect the most difficult vision training cases where some inappropriate perception skills had formed without compensatory skills as might be expected later (and as indeed apparently occurred with three achievers, as suggested previously.) Fourth grade was selected in part for this reason. If vision training did function with these children, the implication would have been that it would function at easier levels. However, since sampling error is obvious, no conclusions may be drawn. The above is, however, a potential hypothesis.

Question 7: Do successive vision analyses reveal differences between the experimental and control groups? Several sets of data may be considered in reaching an answer to question seven. The possibility of using the 21-points findings (see Part I, Appendix E) was considered and rejected. Bing (1951) and others have pointed out that changes in individual scores on the 21-point examination are relatively meaningless. Changes become meaningful only when considered in relation to several other scores. To carry out such extensive statistical treatment on an excessively small and apparently biased sample did not appear advisable and statistical treatment of these scores was not undertaken.

In considering vision differences, scores from tests other than the analytical were evaluated. The mean scores and differences,of six such tests are presented in Table 8 and discussed below.

The examining optometrist was asked a series of questions regarding pursuit fixations of each subject and was then asked to classify generally on a five-point scale (See vision examiners' manual in Appendix E.) The scores for 11 control and 11 experimental subjects were used in this analysis. Significance level is based on 20 degrees of freedom. Significant mean score differences appear at test 2 (after vision training), and at test 3 (after remedial reading), but not after test 4 (follow-up).

Saccadic fixations were considered in much the same way (See Appendix E, Form 11R). Significant differences appear at test 2 (.01 level) and continue at test 3 and test 4 at the .02 level.

For the test, near point of convergence, the examining optometrist was asked to report the distance at which the eyes appear to be no longer converging. These distances were scored to the nearest 1/2 inch and scores of less than 1/2 inch were recorded as 1/2 inch. Test 1 (at beginning of the experiment) shows a non-significant difference; Test 2 (at the end of vision training) shows a significant differenc in favor of the experimental group, a difference which continues through Tests 3 and 4 at the .05 level.

Scores for the stereopsis and eye-hand coordination tests show no differences.

On Form 11, a copying test discussed previously (and included in Appendix B), Test 1 show a .05 level difference in favor of the control group while Test 4 shows a .05 difference in favor of the experimental group. The differences between the mean scores through the four tests move consistently in favor of the experimental group.

Discussion: Sampling problems, discussed elsewhere in this report, indicate that only limited conclusions may be drawn from these data. Within those limitations, however, several of these tests revealed that vision training appeared to affect vision test scores, suggesting that some measurable vision changes do occur as a result of vision training. These tests or similar ones should be useful in subsequent research. All six of the tests used here could be improved and should be tried out with various groups to estimate validity and reliability. The current study utilized many other evaluating techniques no longer useful within this study but which may provide leads for later research.

Question 8: Does intellectual capacity change as a result of vision training or remedial reading? The IQ scores for each of the 22 Ss for each of the four tests are presented in Tables 9 and 10. Changes in IQ points on successive tests and between Tests 1 and 4 were calculated. Although individual score changes ranged from 25 to -16, in no instance was the mean difference score different from zero at the .05 level of confidence. While individual scores did fluctuate there was no change that could be attributed to vision training and apparently none attributable to remedial reading instruction with these 22 children.

Discussion: Given the limitations of generalizing from a small sample the evidence strongly questions the hypothesis of those who wish to claim IQ increases resulting from vision training. "Captive" subjects, a matched control group, and a test-retest design with a reliable test of mental ability are necessary for conclusive evidence on this question.

Question 9: Are Ss in the study representative of the population of patients seen in the office practices of vision training specialists? The generalizability of the results of this research is limited for several reasons. The most obvious reason is the small sample size; a more important reason, however, may be the nature of the sample. While every attempt was made to eliminate cases where there were obvious factors interfering with achievement (such as emotional disturbance, bilingual background, etc.), an important motivational variable may have been overlooked. Parents who can afford to and invest time and effort in regular vision care for their children may not be likely to contract for three years vision care with an optometrist with whom their child has had no previous experience. Clinical reports from cooperating optometrists frequently indicated a disinterest on the part of Ss' families and often a failure to follow through on appointments and/or on home training procedures. Other frequent reports were that Ss refused to wear their glasses as prescribed and that experimental cases were not invested in their vision training. Had these Ss been patients in regular practice they would have been dropped by the optometrist.

Another difference between office practice and the conduct of the study lies in the articulation of remedial reading instruction with vision training. Generally, with the vision training specialists working in the study, the specialists wish remedial instruction to begin at the time when the child's vision skills have reached a level where he can learn to read. Often the school cooperating with the optometrist was unable or unwilling to begin instruction at the appropriate time. Delays were as much as five months. In office practice private tutors who understand the importance of articulation are used. This difference illustrates population differences between the study Ss and the patients in office practice. The cases followed in this research thus may have sampled a population quite different from the population of private vision training cases for whom vision training optometrists report more significant changes.

It was not possible to control for the motivational and vision care experience variables in this study. It was possible, however, to use an empirical base for comparison of study Ss with the patient population seen in private clinical practice. This base is the attrition of cases from the point of diagnosis through referral and treatment.

Five cooperating optometrists were asked to select the fourth grade children examined in their offices during the first six months of 1965 and to list the following information for each:

1. Examination date.
2. Was vision training needed?
3. Was vision training recommended?
4. Date vision training began.
5. Date vision training was completed.
6. Remarks or explanations.

The numbers of children, percentages and level of confidence regarding attrition rate differences are listed in Table 11.

The Kolmogorov-Smirnov two-sample technique for samples over 40 was used (Tate and Clelland, 1957). The levels of significance indicate that the sample of subjects in the study was significantly different in attrition from the samples seen in four of the five practices. (Four were at the .01 level, one not significant).

The study sample was not different in attrition from the total number of patients seen by the five optometrists, although the trend was toward greater attrition in office practice. The office practices of the five cooperating optometrists differ in attrition significantly from each other. (Nine of the ten comparisons were at the .01 level, one at the .02 level)

TABLE 8

MEAN SCORE DIFFERENCES AND SIGNIFICANCE LEVEL ON SIX TESTS OF VISION

		Exp. Mean	(N)	Control M	(N)	Difference	SEdif	Level of Confidence
Pursuits	1	2.86	(11)	2.82	(11)	.04	.255	NS
	2	4.50		3.32		1.18	.329	.01
	3	4.41		3.32		1.09	.309	.01
	4	4.35		3.66		.69	.333	NS
Saccadic	1	2.59	(11)	2.95	(11)	.36	.297	NS
	2	4.27		3.06		1.21	.328	.01
	3	4.23		3.36		.87	.333	.02
	4	4.36		3.64		.72	.283	.02
Nr.Point	1	2.00	(11)	3.36	(11)	1.36	.74	NS
	2	1.46		3.05		1.59	.43	.01
	3	1.59		2.82		2.23	.52	.05
	4	1.50		2.95		1.45	.59	.05
Stereopsis	1	8.00	(10)	7.80	(10)	.20	.75	NS
	2	8.80		7.10		1.70	1.02	NS
	3	9.10		7.70		1.40	1.07	NS
	4	8.80		7.60		1.20	1.05	NS
Eye Hand	1	3.57	(7)	5.62	(8)	2.05	2.63	NS
	2	9.71		6.87		2.84	2.46	NS
	3	10.43		8.87		1.56	2.08	NS
	4	9.71		8.12		1.59	2.22	NS
Flax	1	12.4	(11)	13.2	(11)	-.8	.36	.05
	2	13.1		13.3		-.2	..39	NS
	3	12.7		12.2		+.5	1.01	NS
	4	14.3		12.5		+ 1.8	.89	.05

TABLE 9

WISC Data for Experimental Group

Subject		Psych. 1	Psych. 2	Psych. 3	Psych. 4
1	V	125	120	101	106
	P	120	117	117	117
	FS	125	120	109	112
2	V	125	119	116	111
	P	118	118	122	128
	FS	124	120	121	121
3	V	89	90	85	91
	P	99	97	114	108
	FS	93	93	99	99
4	V	86	90	94	87
	P	93	100	108	104
	FS	88	94	101	95
5	V	100	97	100	99
	P	99	113	113	106
	FS	99	105	107	102
6	V	123	120	120	125
	P	125	121	118	133
	FS	126	123	121	132
7	V	110	113	113	126
	P	100	117	120	129
	FS	106	116	117	131
8	V	100	86	87	90
	P	124	127	131	135
	FS	112	106	109	112
9	V	96	94	92	103
	P	111	125	133	132
	FS	104	109	113	118
10	V	124	114	114	116
	P	120	114	110	97
	FS	124	115	113	108
11	V	120	111	114	110
	P	111	97	118	115
	FS	117	105	117	114

TABLE 10

WISC Data for Control Group

Subject		Psych. 1	Psych. 2	Psych. 3	Psych. 4
1	V	95	113	86	85
	P	113	117	118	106
	FS	104	116	101	94
2	V	96	96	96	100
	P	107	106	114	117
	FS	101	101	105	109
3	V	116	115	118	109
	P	111	132	129	128
	FS	115	125	125	120
4	V	118	104	106	101
	P	125	121	127	124
	FS	123	113	117	113
5	V	105	109	109	100
	P	99	120	113	121
	FS	102	115	112	111
6	V	95	90	87	96
	P	103	103	104	114
	FS	99	96	101	105
7	V	108	104	113	103
	P	125	114	120	125
	FS	117	109	117	115
8	V	92	82	97	85
	P	99	106	108	106
	FS	95	93	97	94
9	V	104	97	101	96
	P	122	113	132	132
	FS	114	105	117	115
10	V	119	110	110	100
	P	120	117	117	129
	FS	121	115	115	117
11	V	130	114	124	111
	P	137	127	136	133
	FS	138	122	133	124

Discussion: Motivation may be a selective factor in the office practice of the optometrists, where the "non-motivated" drop out. If inclusion in the study provided some Hawthorne effect, it served to keep Ss from dropping out of the study. It was apparently not sufficient to cause the children to be motivated to improve as a function of the extra attention they received. Neither was the attention sufficient to make Ss behave like regular office patients.

The fact that office practices differ is expected. A successful optometrist must meet the demands of his own clientele and these can be expected to differ. Furthermore, the skills of the optometrists should also differ from one to the other. What could be remarkable is that the Kolmogorov-Smirnov test reveals the differences so clearly.

One may be tempted to over-generalize from these data. The vision training specialists selected for this study are among the outstanding members of their profession. They are not a cross-section sample and one may not generalize to all vision training specialists from these data.

TABLE 11

Attrition of Patients in Optometric Practice Compared with Attrition of Ss in Study

	Study Group	Optometrist					Total Number of Optometric Patients
		A	B	C	D	E	
Number of Patients	60	52	75	19	72	60	278
	40	42	25	19	40	56	182
	40	37	18	19	17	56	147
	32	29	9	17	12	43	110
	24	27	9	15	10	30	91
Percentage	100	100	100	100	100	100	100
	67	81	33	100	56	93	65
	67	71	24	100	24	93	53
	53	56	12	89	17	72	40
	40	52	12	79	14	50	33

CHAPTER IV. SUMMARY AND DISCUSSION

Introduction

Historically, the concept of vision has developed from acuity and a concrete distinction between the blind and the not blind to binocular acuity, visual skills, visual perception, and meaning. The latter three concepts are not universally accepted as appropriate definitions of vision.

Each of these definitions of vision was discussed in terms of its rationale and measurement variables. Perception is explored more thoroughly as a theoretical construct important to the development of vision training. Percepts, characteristics of percepts, and activity of the perceiver are regarded as the interacting and essential components of perception. Activities of the perceiver include (a) input coordination, (b) awareness, (c) selection of essentials, (d) discrimination, (e) veridicality, (f) retention, (g) recognition, (h) speed, and (i) apperception.

When the term vision is used to imply only blindness or acuity, the relationship between vision and learning to read is obvious. A rather large body of literature, however, uses the term vision to include such visual functions as binocularity, depth perception, pursuit fixations, and other vision skills. Although these studies are difficult to compare in terms of specific skills and measures, they provide evidence of the relationship between inadequate vision skills and failure or disability in reading achievement.

Vision, as used in this study, is regarded as encompassing the concepts of blindness, acuity, binocularity, vision skills, perception, and meaning. Binocularity, vision skills, and perception are the visual functions hypothesized as responsive to training and to learning to read. Changes in the nine perceiver-activities listed above are regarded as objectives of most vision training procedures used today. For the purposes of this study, vision training is defined as any visual, motor, or visual-motor exercises designed to improve visual perception and vision skills. The use of this definition of vision training is clarified by the visual functions measured and consequently by the instruments included in the vision examiners' diagnostic manual.

The literature on vision training includes efforts to systematize training procedures and several sophisticated attempts to conceptualize the relationship between development of specific visual functions and perceptual tasks such as reading. While there is considerable overlap in the vision skills regarded as important and responsive to training, the use of different terms, concepts and orientations makes it difficult to arrive at a generally accepted and accurate definition of vision training.

Since vision training, like other clinical treatments, is individualized to meet a particular patient's needs, evaluation of vision training effects needs to allow for the same kind of individualizing of treatment as found in office practice. Controls are needed, however, if the evaluation is to show what happens to the same kind of patient if he does not experience the treatment in question. This study attempts to approximate vision training as it is clinically practiced, within the framework of empirical experimental procedures such as standarized testing, no-treatment groups, and controls for other variables that might be related to the outcome criteria. Vision training from the point of view of the vision training specialist is farther developed in the manual prepared for those doing vision training in the study. (See Appendix F.)

This study is an attempt to evaluate the effects of individualized vision training in a group of fourth grade children who are both disabled in reading and diagnosed as having inadequate visual skills. The effects evaluated include both (1) changes in vision and (2) the relationship of vision training to reading achievement.

Procedure

The research design involved the participation of optometrists, schools, psychologists and remedial reading teachers in several states. Fifty-one optometrists agreed to contribute the time required for 16 or more complete vision analyses, and to provide visual training for at least one case. Approximately 23% of the schools (in the optometrists' respective communities) whose cooperation was requested agreed to participate. A cooperating optometrist with a cooperating school was considered a center. At the beginning of the sample selection procedures, there were 30 active centers. The cooperating schools sent lists of fourth graders with school-administered group IQ tests and achievement test scores. Group test scores were reviewed and 444 children were selected as potential disabled readers and referred for individual psychological testing. Individual psychological evaluations included the Wechsler Intelligence Scale for Children; Gates Reading Survey; Bender, Form No. 11; and the Draw-A-Person.

Of the 370 who completed psychological evaluations, 112 children (1) were reading at one or more years below their grade expectancy level and (2) were judged as not possessing factors known to interfere with reading achievement such as bilingual backgrounds, family disturbances, etc. These children were referred to cooperating optometrists for complete vision analyses, if their parents agreed to the referral. Parents of 44 children did not grant permission for vision analyses. Eight children who were scheduled to receive vision analyses were eliminated for reasons other than research criteria (e.g., school reversed decision to cooperate, family moved, test records incomplete, etc.) Of the 39 cases referred for vision training, 7 cases were eliminated by circumstances outside the limits of the project.

Of 59 cases who received complete vision analyses, and whose vision test records were reviewed by the project's consultants, 20 cases were rejected as subjects on the basis of having no vision problem, as having a vision problem not subject to vision training, or as not appropriate for vision training.

The final sample consisted of 32 fourth graders, each of whom exhibited a reading age of one or more years below his mental age, and whose vision analysis indicated the need for vision training. Cases were assigned to either the experimental or control group. Experimental cases received vision training after which both experimental and control subjects received the same treatment of (1) second vision analyses and second psychological evaluations; (2) remedial reading instruction; (3) third vision analyses and psychological evaluations; and (4) several months later, fourth vision analyses and psychological evaluations.

Thirty-one cases were followed through the two-year procedure, although in some instances not all the data were complete and/or comparable. There were 22 cases in the final statistical analyses.

Results

Major findings were organized into nine sections and specific questions, evidence, and implications are discussed. In summary form, the findings are as follows.

1. Incidence of reading disability in fourth grade children as measured by group test scores: School-administered group test scores of intelligence and achievement that were reviewed for this research indicated that 10% of the fourth grade population in those schools were underachieving in reading by one year or more. This is likely to inaccurately represent the incidence of underachievement in reading in the general population for several reasons. Only a particular area of the country was sampled and the scores examined were from only those schools that agreed to cooperate in the research. The many schools that refused to cooperate may, for complicated and interacting reasons, have a higher incidence of underachievement. The simple test score criteria may not be an adequate assessment of "achievement". The specific instruments used to measure mental ability and achievement varied from school to school, and included a wide range of reliability and validity of measures. Finally, underachievement may be more appropriately assessed when local (to a community) norms and criteria are regarded.

2. Do individual assessments of intelligence and reading achievement confirm group test predictions of reading disability: Of the 370 cases who received complete individualized assessments of intelligence and achievement, 354 were considered valid estimates and 112 (31.4%) of those cases were reading at one or more years below mental age. If group test scores were highly valid and reliable, a high percentage of the group tested individually could be expected to show a reading disability. This points to the relative unreliability of group test scores, and probably to the unreliability of the assumption that scores from different group tests which ostensibly measure the same thing are comparable to one another.

3. Incidence of vision training referrals in a population of disabled readers: Of 59 vision analysis records examined (reading disability previously diagnosed), 39 cases were diagnosed as able to profit from vision training. Most of these (32 cases) were diagnosed as able to profit from vision training in conjunction with remedial tutoring. While this diagnostic percentage (66%) cannot be taken as a base rate for the general population of children underachieving in reading, the important implication is that clinical optometrists involved in vision training do not perceive all disabled readers as likely to respond to vision training treatment. Equally important, the high incidence of agreement among cooperating optometrists and project consultants suggests that among vision training specialists there is a consensus on criteria for referral for vision training.

4. Prediction of reading disability by the Bender Visual Motor Gestalt Test: From the 370 complete individual assessments of intelligence and reading achievement, 101 students were identified as underachievers in reading, and 56 students were identified as achievers in reading. The latter "achievement" criterion was a reading age score of two or more months above mental age level.

Bender scores showed no differences between the 101 underachievers and Koppitz' norms for average performance at the same age. While the norms are based on a much smaller sample, it does not seem likely that the normative population was that atypical. A more plausible hypothesis is that the Koppitz scoring system is not sensitive to changes in visual-motor development at the age of ten.

Mean Bender scores for the 22 Ss used in the final analysis do not differ from the Koppitz norms. Experimental-control group differences changed sporadically from one evaluation to another, and cannot be accounted for by the experimental variable of vision training.

Interestingly, the mean Bender score for the achievers was significantly lower than the Koppitz norms ($p<.01$), although four unusually high scores (low performance) account for most of the variance in the achiever group. Even so, the unexpected finding warrants some attention. Possible explanations include (a) considerable compensations for inadequate visual-motor skills, or (b) Koppitz-Bender scores at this developmental level are not related to visual functions important to reading achievement.

5. Form 11: prediction of reading disability by performance in copying and reversal copying of diagonal forms: Form 11, a copying test suggested by the project consultants, and directed toward measuring perception and reversing of diagonal lines. The test was evaluated in terms of its diagnostic value in differentiating underachievers and achievers in reading. Ss included those children described above as receiving individual psychological assessments of intelligence and achievement and for whom Form 11 scores were available.

A master's thesis done in cooperation with this project (Aurand, 1964) provided reliability and normative data for further comparison.

Aurand reported relatively low reliability of Form 11 scores when scored as number correct. She further reported that time as a score did not differ substantially from number right, and that scores for copying and reversed copying were not markedly different.

There were no significant differences in mean scores among under-achievers, achievers, and the Ss followed in the major study. All of these groups, however, had considerably higher mean scores than Aurand's normative sample. These differences may be accounted for by differences used by the respective scorers, or by actual differences between the project sample and the normative group. The latter seems less likely, because the direction of difference is in favor of both disabled readers and achievers.

The usefulness of Form 11 for diagnosing disabled readers would seem to be in observation of how the child reverses his perceptual field rather than in formal scoring differences. Results of using Form 11 with Ss in treatment, however (see below), suggests its usefulness in assessing change as a result of vision training.

6. Relationship between vision training and changes in reading achievement: Analyses of variance between experimental (N=11) and control (N=11) groups and between the four complete psychological assessments at various points in the study (before vision training, after vision training, after remedial reading, and follow-up) revealed no statistically significant differences in reading achievement scores or in reading disability scores. Analyses of variance between experimental and control groups and between cumulative psychological evaluations (first test scores compared with second; first test scores compared with third; etc.) showed no significant differences in reading achievement and reading disability scores between those who received vision training and those who did not. The only statistically significant differences ($p < .05$) are found in cumulative reading age gain and cumulative disability scores across experimental and control groups. These results indicate that both experimental and control groups increased in reading age scores and both groups increased in reading disability although the groups did not differ from each other in either score.

Conclusions, from a sample of 22 cases, should not be interpreted as conclusive evidence that vision training has either impact or no impact on reading achievement among any population of fourth grade disabled readers. While these results do raise important questions, the research issues discussed in Chapter III and summarized below precludes any generalization that implies replication of what actually occurs in clinical practice of vision training. The supposed disparity between these findings and reported clinical findings could be used more heuristically, not only toward more refined systematic research efforts but also toward promoting refinement in vision training concepts and procedures and the wider dissemination of knowledge about vision training.

7. Differences in vision test scores between experimental and control groups and between successive vision analyses: Pursuit fixation mean scores were significantly different ($p < .01$) between experimental and

control groups after experimentals received vision training and after both groups received remedial reading. There were no differences between groups at the follow-up examination or at the beginning of the study. This particular visual function appeared to improve with vision training and to be maintained for some time but not for the duration of the follow-up period.

Saccadic fixation scores between experimental and control groups did not differ at the beginning of the study, but did differ in favor of experimentals after vision training ($p < .01$) and continued throughout the duration of the follow-up examination.

The near-point convergence measure shows the same pattern. There were no differences between groups at the beginning of the study, but the experimental cases scored significantly better ($p < .01$) after vision training. Their difference ($p < .05$) was maintained throughout the next two examinations.

Form 11, mentioned above, also shows some differences between experimental and control groups ($p < .05$). These score differences appeared at the beginning of the study and at the follow-up examination. The difference at the beginning of the study, however, is in favor of the control group, and by the follow-up examination, the difference is in favor of the experimental cases. The most obvious inference is that whatever visual functions Form 11 measures did improve dramatically for the cases who had vision training and, although fluctuating mildly, they showed even more improvement at the follow-up vision analysis.

Stereopsis scores and eye-hand coordination tasks showed no differences between experimental and control groups throughout the study.

In general, then, of the visual tasks measured and compared, pursuit fixations, near point convergence, saccadic fixations, and perception of diagonals (or whatever function is measured by Form 11) did show improvement with vision training. Pursuit fixations is the only measure evaluated that showed improvement without showing sustained improvement.

8. Change in intelligence: There was no evidence of change in group mean intelligence test scores from the first psychological assessment to any of the other evaluations during the course of the study. This finding contradicts some reports in the literature that vision training can have a direct impact on intellectual functioning.

9. Comparability of groups: While comparable to the total numbers of children seen by five leading vision training specialists, the subjects in the present study differed significantly in attrition during vision training from the office practices of four of the five specialists. Furthermore, the patients in the office practices of the five specialists differed significantly in attrition from practice to practice.

Interpretation

Motivation was considered in question 9 of the preceding chapter. In that section it was pointed out that thechildren in the experiment may well have been different from the children in the practices of the various optometrists. In fact, the motivational aspects of the patients in the offices of the various optometrists may well have differed and that these differences in motivation may account in part for the success of the optometrists. In Chapter I it was noted that the investigators of the study attempted to reduce the possibility of Hawthorne effect by informing both groups of children that they were participating in an experiment and by having the same teachers and optometrists with experimental and control children. Since there was no apparent difference between the two groups, it strongly suggests that the investigators were successful in overcoming the Hawthorne effect. However, it appears to the investigator almost uncanny that there wasn't even a smidgen of Hawthorne effect operating. It is possible that the motivational patterns of children involved in the study were a deciding element in the failure of the study to yield conclusive results on its major question.

Investigators were impressed during the course of the study with the implication that vision is not everywhere the same. When a child's vision is being examined in an optometrist's office, his attention is on vision, on the act of seeing. When a child is learning to read, his attention is on learning to read, not on vision. On the other hand, when a child is reading his attention is upon comprehension. It is neither on the act of reading nor on the act of seeing. Variations in the ways the eyes are being used during reading are observed by the many optometrists who use book retinoscopy. The use of such a test is controversial. What is important to note here is that the accommodative facility of the eye changes during the act of reading as the child concentrates more on comprehension and less on reading or on vision. How the test scores are to be interpreted and whether they are reliable is a matter for the professional optometrist. Our point here is merely that the eyes in use change with the purpose of the reader.

The visual requirements of the reader vary as reading changes. The learning-to-read task also changes year by year. The major focus of the reading act of the first grade child is upon word recognition and upon the recognition of the meaning as it compares with the previous experiences of the child. At the fourth grade level, the child is thrust into reading as a means of creating experiences rather than as a means of reliving experience. As the child proceeds in learning to read at the higher levels, he becomes more conscious of evaluating what he is reading and learning in an effort to assist him in determining a course of action. Furthermore, when reading within content fields such as georgraphy, mathematics, history, or literature, the individual and specific purposes for which the child is reading may easily shift, for example, from enjoyment to intrigue, from disbelief to belief, from retrospection to looking ahead, from recognition to retention, or from disorder to organization. It is very likely that what occurs visually differs as the tasks of reading and of learning to read differ. This precludes the possibility of an uncomplicated explanation of the relationship between vision skills and reading.

Vision is a complicated activity; perception is a complicated activity; reading is a complicated activity; learning to read (and teaching it) is a complicated activity; vision training (both learning it and teaching it) is a complicated activity. No simple answer regarding interrelationships among these five is possible today other than that some children (and adults apparently) are being helped through vision training to see and to learn. These children are screened by knowledgeable optometrists to eliminate those who cannot learn and are further screened by the elimination of those unwilling to invest time and energy in the effort to learn. Similar screening, of course, occurs in the office practices of other professionals. Furthermore, teachers note (and often over-credit) the students who "try," and who invest time and effort in learning.

We have reserved for last a comment regarding attitudes toward research that were encountered within the structure of public education. It seemed to us only logical that all school personnel from classroom teachers to members of the various boards of education would be willing and anxious to cooperate in the serach for truth and knowledge. Unfortunately, many educators are willing to cooperate only (a) if the school can be shown to be in an advantageous position, (b) if established routines are not disturbed, (c) if it doesn't cost anything, (d) if not even one parent questions the project, (e) if ophthalmology or other pressure groups do not object, or (f) if the research could be redesigned to meet personal biases. Fortunately, there are educators who do agree that the unbiased collection of valid evidence is vital to research which in turn provides direction for the development of education. Each of us must present this point of view as often and as convincingly as possible so that increasingly more educators will become willing to participate in research.

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Appendix A

Case Study Summaries

The following section includes summarized case studies of the 22 children included in our final analysis. The information included is not included to be complete discriptions of treatment; rather, the intent is to provide a brief comparative overview of both experimental and control cases.

Experimental cases are presented first, and are coded by letter with their respectively matched controls. The following abbreviations are used in the summaries.

O - training optometrist

P - psychologist

R - remedial reading teacher

VA - vision analysis

Psych. - psychological evaluation

VT - vision training

RR - remedial reading

CA - chronological age

MA - mental age

RA - reading age

DIS - reading disability (difference between MA and RA)

VIQ - Verbal IQ score

PIQ - Performance IQ score

IQ - Full Scale IQ score

Case: Experimental A

Sex: Male

6/3/63 Psych. 1 CA=9-9, MA=12-3, RA=9-1, Dis.=3-2, VIW=125, PIQ=120, IQ=125. "Spent 2 years in remedial reading, is slow and deliberate, vocabulary limited. Comprehension, sentence structure, and writing are excellent, apparently no serious physical, social, or emotional problem. Stutters slightly...lack of drive...father: 'all the family's like that:'...stable, coordinated, pleasant..." When asked to draw a person he drew an old woman. (P)

7/15/63 VA 1 "quiet in responding but he tries hard...acuity a little under normal at far...his lenses have been broken 4 months, parents unable to afford repair...better spatial judgments without lenses than with...definite suppression of left eye, when forced to use both eyes, he fatigues rapidly ...full plus near and far on refractive, but skills diminished rather than increased...not sure of himself in directions and shows some reversals. Coordination is fair. Retinoscopy shows a rigidity. Recommended: VT then lenses followed by remedial reading. He will probably respond to training slowly due to rigidity but will be very cooperative ...mother is very cooperative too. (O)

Mother: "2 half-sisters older, one younger brother....glasses prescribed 6/62 for astigmatism ...daydreams, sensitive, stutters..."

9/63 Lenses Prescribed

9/63-3/64 VT Thirteen office sessions and approximately 29 home training sessions

3/13/64 Psych. 2 CA=10-3, MA=12-4, RA=9-9, Dis.=2-7, VIQ=120, PIQ=115, IQ=120. Comments on first Psych. repeated. Does not wear glasses, lost them twice this winter, blames mother. Drew an ambiguous figure. (P)

3/16/64 VA 2 He is seeing much more, better oriented in space world and leads with eyes then follows with hands ...more stability though tires easily at near point tasks. Attention span is longer and he is eager to try...much physical tension is gone, less clumsy...mother says he is doing better in school. Overall...he has cooperated very well, but seems eager and asks more questions now. (O)

3/18/64 5/15/64	RR	35 sessions with a class. Family is moving to a nearby community...Final testing showed 1.5 years gain in reading achievement since fall...wore his glasses seldom during remedial reading. In general, remedial reading work was deliberate and good relative to class. (R)
9/16/64	Psych. 3	CA=11-1, MA=11-2, RA=9-5, Dis.=1-9, VIQ=101 PIQ=101, IQ=101, DAP=male, no summary. (P)
9/9/64	VA 3	-----
10/18/65	VA 4	"...in three schools since we started. He read 7th grade material...good comprehension...higher frustration level. Metropolitan reading... grade 5.8 (O)
10/20/65	Psych. 4	CA=12-2, MA=13-8, RA=10-8, Dis.=3-0, VIQ=106, PIQ=117, IQ=112. "He was cooperative and relaxed...Wore glasses... speech block...stuttering is more marked. Did not try difficult items...and he stopped when forced to guess. (P)

Case: Experimental B
Sex: Female

6/10/63	Psych. 1	CA=9-7, MA=11-11, VIQ=125, PIQ=118, IQ=124, RA=10-4, DIS=1-7. "Test results apparently reliable...consistent with previous group tests...parents recently aware of perceptual difficulties...were in the process of securing help when she was selected for this study. (P)
7/15/63	VA 1	VT estimated 16 weeks..."has difficulties in pursuit strength, saccades, accommodation-convergence relationship (needs Rx & fusion training), form perc., directionality, general agility, and motor coordination. She drew a female "holding arms out because something is wrong with them." (O) Parents..."reversals, spelling and writing very poor, enjoys reading"...began school at age 4, changed schools 4th grade...sensitive, inattentive, bites nails, sleep disturbances, overcritical of others."
9/5/63	VT	Forty-four sessions.
2/13/64		"further improvement not possible now, D was cooperative but not motivated for effort at improvement. Reading easier, doesn't lose place. She has made as much progress as can be expected at this this point. (O)
3/16/64	Psych. 2	CA=10-4, MA=12-2, RA=10-6, VIQ=118, PIQ=115, IQ=118, DIS=1-8. "...outgoing, lefthanded, difficulty at paper orientation...obtained ratings felt to be appropriate." (P)
3/23/64	VA 2	"she is superior visually to pretraining level, would have preferred to get tachistoscope up more, and better form on test. Personally her attitude and concentration has improved in school as well as her ability to enjoy reading. Recommend increasing strength of lenses to aid fusion." (O)
5/4/64	RR 3	3 one-half hour sessions (she enrolled in regular school remedial classes. She was kept out of class by the school's decision during VT).

6/64	Report to Parents from school	Gates Survey Form 2: speed 6.7, Voc. 6.4, comprehension, 5.3. Others phonics and spelling below 4th grade; silent reading low--low 5th grade level. (R)
10/1/64	RR 2	Thirty-one, one-half hour sessions in class of four. "Reading with improved interest and understanding, vocabulary & expression growing, spelling errors persist, tach. work lowest in gp. of 4, word att. more successful, interest & effort very high level." (R) Kept in remedial reading class by school.
12/16/64	Psych. 3	CA=11-1, MA=13-5, RA=12-11, VIQ=116, PIQ=122, IQ=121, DIS=6. "Reasonably well integrated and coord., some practice effect..."don't know" responses given quickly. Still trouble with paper orientation, no evidence of physical maturing... principal indicated considerably more maturity in behavior this year...apparently well-adjusted. (P)
4/15/65	VA 3	Report missing. "She now reads for pleasure 'as often as I can.'" Letter from parents: Questions about study and progress. Reply sent 4/22.
6/65	Report to Parents from school	Gates Survey Form 3: Speed 7.8, Voc. 8.0, comprehension 6.5. Other: Grade 5 to 6+, spelling med-4th "appears that she should be able to meet reading require. of grade 7 with reasonable success...errors in spelling, repetition in oral reading and reversals not completely overcome, but diminished. She showed new interest in new words...enthusiastic." (R)
11/5/65	Psych. 4	CA=11-11; MA=14.5; RA=12-0; DIS=2-5; VIQ=111; PIQ=128; IQ=121 "Had initial difficulty with Block Design...and recovered and obtained an adequate score,...Figure drawing is inadequate." (P)

Case: Experimental C
Sex: Male

6/13/63	Psych. 1	CA=11-1, MA=10-4, RA=8-0, DIS=2-4, VIQ=94, PIQ=98, IQ=96. Much the same behavior as exhibited previous testing given 1/62. From that report: referred because of reading difficulty... related easily to examiner, cooperative, seemed to be well motivated...some qualitatively poor responses...immediate recall of digits much below other scores...motor coordination seemed within normal range...occasional slight irregularity of of hand when writing...drawings show no perceptual defect...sometimes difficulty in integrating elements properly...able to improve productions... speech is hesitant and contains many immaturities in articulation and language development perseverance or rigidity of thinking exhibited in some vocabulary items...definitions characterized by concrete thinking...perceptual difficulty indications in describing pictures that may be result of figure-ground disturbance. Similar confusion in puzzle type tasks. (TR)
7/24/63	VA 1	VT estimated: 32 sessions. "definitely disadvantaged," operating on a low tactual-visual level, poor motor control and confused. Specific benefits of VT include good space interpretation, all-round improved visual performance at near. For any significant improvement, lense should be introduced near end of VT...Remedial reading alone would be and has been ineffective. (O) Parents are very deaf, no evidence of deafness in EC at this time, 3 years ago had Rx of OS+75, OS+50 to be worn for one year. (O) #8: parents one high school grade; EC is middle of 3 sons; remedial work at home; 1st grade repeated; dislikes reading; reverses; daydreams. 7/63
12/13/63- 4/15/64	VT and VA 2	30 sessions: Definite improvement in visual performance; attention span significantly increased; discomfort, tearing, other symptoms disappeared, occasional confusion of b's and d's; visual space and spatial relationships of number show marked improvement, gross motor coordination is well on its way; fine motor control is moving slowly but shows progress; shift in posture in writing is tense but becoming more natural. Parents have been cooperative... more supervision at home would have been helpful; great deal of additional training is necessary. (O) Research director OK'd further training.
5/27/64	Psych. 2	CA=12-0, MA=11-2, RA=7-7, DIS=3-7, VIQ=90; PIQ=97, IQ=93. "Cooperative & attentive...impression that his efforts at some tasks are fruitless but he continues to try as as asked to do." (P)

4/15-6/10/64 RR	18 sessions. "Slight progress": (R)
7/20-8/14/64 RR	12 sessions "great progress since September: long way to go yet and individual help is necessary" (R)
10/1/64 VA 3	Performing visually at satisfactory level...all tests indicate continual improvement...present Rx for school & study is adequate and must be worn... more poise and self confidence...gross and fine motor coordination is readily apparent in posture movements and authorities report that school is much easier and sometime fun. Timing in problem solving, writing, speaking is less than desirable but significantly better. Effectiveness of remedial reading is open to question...family situation requires instruction in phonics, enumeration, pronunciation and assistance in developing a speaking and reading vocabulary...expected to occur in time but probably outside the scope of this study.
10/5/64 Psych. 3	CA=12-4, MA=12-3, RA=7-8, DIS=4-7, VIQ=85, PIQ=114, IQ=99. "relaxed during test, knew what to expect, possibly performed better because of familiarity with some items." (P) Results of VT indicate reduction in symptoms, i.e., "eye-strain" reading. Results of remedial work indicates improved reading ability.
10/26/65 Psych. 4	CA=13-5, MA=13-3, RA=8-1, DIS=5-2, VIQ=91, PIQ=108, IQ=99. "Pleasant, productive relationship was established." (P)
10/21/65 VA 4	"Motor movement smooth and more graceful. Maintains better posture. Conversation is smoother, more extensive, coordinated. Manner of speaking and vocabulary not too different from beginning, still indifferent to his problem. Motivation and interest of parents was minimal." (O)

Case: Experimental D

Sex: Male

8/2/63 Psych. 1 CA=10-9, MA=9-6, RA=8-6, DIS=1-0, VIQ=86, PIQ=93, IQ=88.

"poor insight in block design, enjoys testing situation, gives up easily, needs urging" (P)

10/30/63 VA 1 VT recommended for estimated 10-12 weeks. Low hyperope, poorly organized in near visual space, inconsistent responses, husky boy, cooperative. He does not always follow instructions well, which is probably a perceptual problem. His low average mental ability will always restrict his scholastic performance; VT and glasses however, followed by remedial tutoring, should improve his ability to handle the printed symbol. (O)

Parents: He is a very fidgety child, craves attention, becomes upset easily, and is nervous; 2 younger sibs; difficult pregnancy...toxema; walked at 9 months; used sentences at 1 year; likes anything mechanical; bronchial asthma from infancy to age 7; best school subject is spelling; arithmetic, poorest. In grade 2, teacher hit him and he lost bladder control for 3 months; repeated grade 3; family moved during grade 3; frequent change of teachers; passed vision screening in school; eyes hurt when he's extremely tired; dislikes reading and reading subjects; daydreams, shy, sensitive, inattentive, fearful, thumb or finger sucking, nervous, attracts attention, overactive. He was sick in bed day prior to VA.

11/14/63 VT Fourteen sessions plus home training.

Difficulty getting cooperation from parents with home training. On 1/6/64, ultimatum on wearing Rx and cooperation with home training was given. He missed 2 weeks of school (and VT) with flu. 2/20: more home training, especially elevated walking rail. At 3/10 parent conference it was learned that the walking board not yet obtained. Mother explained, "another child in family--brother ill." (O)

3/30/64 VA 2 "still many inconsistencies in reporting at near, when aroused properly, reporting improves but not sustained...is more sure of himself, more aware of where he is, less likely to quit at first perceptual mishap. He shows a greater willingness to try to work through a problem...He was very successful individually in basketball this year, all-star, etc. A gifted remedial reading teacher may help with reading. Interest and motivation are problems. He is working against negative parents. Training did not fully achieve original

	goal. There was a breakdown in control of case, so stopping completely at this stage seems best. (O)
4/15/64 Psych. 2	CA=11-6, MA=10-9, RA=8-8, DIS=2-1, VIQ=90, PIQ=100, IQ=94. "no indication of personality or emotional disturbance" SP 4/64
5/64-11/64	Contracted remedial tutor left town. Great difficulty getting remedial reading services. Success 11/64
3/10-4/23/65 RR	Thirty 1-1/2 hour sessions. He is accustomed to bluffing; has very poor work habits. (R)
5/11/65 Psych. 3	CA=12-6, MA=12-8, RA=10-4, DIS=2-4, VIQ=94, PIQ=108, IQ=101. Reading grade achievement has increased 2 years in one year. (P)
5/21/65 VA 3	"Quite sure of himself in all ways, moves around often with confidence 'My eyes are better--I don't need my glasses anymore!' has not worn his glasses over past year. He was told that he still needs them...Visually, he has greater freedom of operation. There are still holes in his overall performance. (O)
10/28/65 Psych. 4	CA=13-0, MA=12-4, RA=9-10, DIS=2-6, VIQ=87, PIQ=104, IQ=95 "repeated third grade...presently repeating sixth grade." (P)
11/16/65 VA 4	"very sure of self...borders on being cocky. Visually his analytical shows little change from last exam. Retained his low hyperopia. He benefited from training by better organizing of his space world. Routines helped him build better appreciation of where he is." (O)

Case: Experimental E
Sex: Female

7/12/63 Psych. 1 CA=10-1; MA=10-0; RA=8-2; DIS=1-10; VIQ=100; PIQ=99; IQ=99.

"She very quiet and uncertain of herself; showing some evidence of emotional disturbance. Mother died two years ago. She is having difficulty accepting new mother." (P)

8/27/63 VA 1 "She may be having some emotional difficulty... does not get along very well with stepmother and is rather shy and reticent. It is felt that her visual problem is important factor in reading retardation. While not apparent from the enclosed forms, she cannot adequately sustain a visual task in time. As examination progressed, she became less and less proficient at near point. VT and lenses should remove the effort with which she must function at a near task, and allow her to perform at the near point for longer periods of time. Headaches reported.

Parents: 5 sibs, 4 younger.
First walked at 11 months; first said words at 18 months; first used sentences at 20 months.
Has nightmares.
Best school subjects are art, religion, geography.
Poorest subjects are arithmetic and reading.
Tilts head while reading and word calling; uses finger as marker while reading. Confuses words that look alike. Unable to remember what has been read; facial distortions while reading; signs of tension during close work; has difficulty finishing assignments; daydreams; quarrelsome; restless; inattentive; sleep disturbances; overcritical; ridicules others.

12/3/63 to 2/11/64 VT Fifteen sessions plus home training.
All through 1.50 spheres

2/11/64 VA 2 No significant change. Significantly increase in positive and negative fusional reserve at near; occular mobility improved; pursuits and saccadics good; Van Orden Star point produced on second trial no headaches.

4/14/64 Psych. 2 CA=10-10; MA=11-5; RA=9-9; DIS.=1-8; VIQ=98; PIQ=113; IQ=105.

"She appeared very quiet; uncertain...preferred to answer with 'I don't know', when pressed, able to give correct response. Some evidence of anxiety; also anticipation of failure on performance subtests, she was inclined to be careless and quick, as if eager to dispense with the task." (P)

3/64-8/64		Attempts to find remedial teacher. Success 8/64.
10/24/64		Family moved; no forwarding address.
11/3/64		Relocated family; remedial teacher contacted for tutoring arrangements.
11/10/64	RR	10 sessions of remedial reading sessions. "marked improvement in recognition of vowel sounds and ability to use them; only a beginning in syllable study; progress with plurals and suffixes; greatest progress in comprehension...During all lessons she was willing to work entire hour with interest; wore glasses all the time while working; Parents report that little progress made this year in school work" (R)
1/11/65		Project offered to pay Mr. Ring's mileage to remedial sessions unanswered.
2/9/65	Psych. 3	CA=11-8; MA=12-5; RA=10-5; DIS=2-0; VIQ=100; PIQ=113; IQ=107. "still necessary to encourage response; Mr. Ring upset because stepmother took her out of school for testing...failing in arithmetic, science and social studies...stepmother says she is more interested in boys than studies; apparently both parents pressuring her to achieve, to which she responds by withdrawal or avoidance...bites her nails...Bender counted dots and loops compulsively...dissatisfied with first Draw-A-Person so she submitted Forest Ranger on second try.
2/16/65	VA 3	P & S are still good; increase in PFR and NFR have held. "Wearing Rx, visual difficulty appears to be eliminated. Present Rx (1.00 sph. OV) appears adequate." (O)
10/12/65	Psych. 4	CA=12-4; MA=12-7; RA=10-4; DIS=2-3; VIQ=99; PIQ=106; IQ=102 "she related well to examiner but is still unwilling to exert herself and prefers to respond with an 'I don't know.'" Inclined to be careless on the Performance subtests. (P)
10/12/65	VA 4	"Her visual symptomatology appears to have been eliminated. The purely visual errors which were present prior to Rx and training have disappeared.' (O)

8/9/65- 8/12/65	RR	22 sessions His recognition problem occurs in middle of words, especially short vowels u. e. and i. He shows a tendency to confuse a and u. He spells phonetically not seeming to recall appearance of words. Spelling difficulty is compounded by inadequate knowledge of vowel sounds...Vowel weakness appears to be the cause of deficiency in syllabication and in large measure for recognition problems. This problem with vowels largely can be corrected with normal training. (R)
8/17/65	Psych. 3	CA=11-2, MA=13-6, RA=9-7, DIS=3-11, VIQ=120, PIQ=118, IQ=121 Intellectual functioning as evaluated by WISC quite consistent with previous test scores. His gains are not at all in keeping with his basically superior intelligence. (P)
4/23/66	VA 3	Fusional ranges have further improved so that the case no longer "types" as a B-2 problem, although #17B recovery is still low. Continued improvement as noted in ductions, is also evidenced in accommodative ranges. On 12/9/65 his father noted that he is impressed by his newfound participation in league sports, basketball, etc. He is very pleased with his son's new development in this past year.
6/17/66	Psych. 4	CA=12-0, MA=15-10, RA=12-6, DIS=3-4, VIQ=125, PIQ=133, IQ=132. Significant gains in performance score...remarkable gains in reading test speed and comprehension. (P)
9/1/66	VA 4	Neither Rx has been worn much in recent months, since not much reading has been required. But the glasses usually have been worn for sustained reading. Astigmia is no longer measured. There is an occasional tendency to show myopia of -0.25 on July 20, but by 8/18/66, the best subjective is plano, each eye and binocularly. ##11 and 17B have again dropped, but the exophoria at near is more normal. Accommodation ranges remain quite excellent. Plus acceptance and desirability at near has remained near constant. He still requires plus at near to come into good rapport for sustained processing information from the printed page. Convergence ability and tachistoscopic ability remains superior.

Case: Experimental G

Sex: Male

6/4/64 Psych. 1 CA=9-5, MA=10-0, RA=8-10, DIS=1-2, VIQ=110, PIQ=100, IQ=106

Basic intellectual potential estimated somewhat better than test scores indicate. Considerable anxiety interfering with his functioning. He becomes tense and anxious in his eagerness to please and he stutters when he becomes anxious. I feel he has a dominance problem. Found Block Designs frustrating...unable to reproduce any of block patterns from cards but could from the examiner's models. (P)

7/22/64 VA 1 He demonstrates a "B-2" visual problem (Intensified Near Problem), deteriorated only to stage one, but with a low #21 finding. He is highly motivated to want to help himself. Parents have demonstrated their interest and even enthusiasm for vision therapy methods. (O)

Parents: Dislikes to read and avoids it as much as possible. At times he is jittery and tense and he cries easily. Two brothers, ages 8-1/2 and 6. First walked alone at 10-1/2 months; first said words, 8-1/2 months; and first used sentences, 18 months. Very good at swimming and poor at word games and puzzles. Tonsils removed at age 5 years following numerous sore throats, swollen glands and temperature of 105°-106°. He is argumentative, helpful, wants responsibility. Entered school at age 4-1/2. His best subjects are arithmetic and his poorest subjects are Science, Reading, and Spelling. Confuses words that look alike. Often cries when told to read.

He is discouraged, sensitive, quarrelsome, restless, unhappy, temper display, untruthful, sex misbehavior, speech defect, lack of bowel control, bullying, overcritical, ridicules others, imaginative lying, and crying.

12/2/64- 12/22/65 VT 1 71 sessions plus home training.

5/17/65 Psych. 2 CA=10-4, MA=12-0, RA=10-7, DIS=1-5, VIQ=113, PIQ=117, IQ=116.

He did not work as carefully as he might on the Bender, Draw-A-Person, and Copy Test--they were somewhat impulsively and carelessly done. Behavior change in past year is marked...much less tense, enjoys school more, good progress. (P)

6/4/65	VA 2	He now can demonstrate an impressive duction ability and no longer "types" as a vision problem. Accommodative ranges also are much increased. The two eyes are more nearly alike in function, but the left eye shows 0.25 dio. more myopia at distance, yet more plus acceptance at near. Motilities and tachistoscope testing show large gains. Eye preference was not changed but behavior has changed markedly. His mother reports (April 10, 1965) that his teacher says that last week's test show a gain of 2 years in mathematics, 1-1/2 years in reading. His mother commented: "He is almost unrecognizable --almost a new individual--Never could believe there could be so much change in so short a time...He takes on responsibility--goes out with ball teams--complete change in behavior...No problem managing his behavior now...did not realize he would need reading training. His teacher is pleased with his reading. His reading is now at the 5th Grade level or better, I think...big change in reading and solving math problems...Big change in understanding arithmetic...I guess it all involves reading...I don't know what to attribute changes to except visual training...He is happier, too."
6/9-8/6/65	RR	30 sessions. Low sight vocabulary is one of his principal weakness. He is able to recognize directly stated facts, draw inferences, follow sequence of events, and recall significant details. He does not reach broad generalizations and conclusions about material easily. The major problem seems to be dealing with words in isolation. The letter "c" pronounced as "s" continues to trouble him. (R)
9/10/65	Psych. 3	CA=10-8, MA=12-6, RA=10-2, DIS=2-4, VIQ=113, PIQ=120, IQ=117. Interested in tasks and concerned about performance. He was critical of his paper and pencil performance but made little effort to correct his mistakes. Subvocalized while doing Gates and sighed considerably during this test. (P)
4/28/66	VA 3	He complained of a virus, etc., on dates of the vision analysis. ##11 and 178 were lower than on V.A. #2, but prism convergence and pos. fus. res. were especially excellent, and accommodative ranges were still quite good. Motilities were excellent.
6/16/66	Psych. 4	CA=11-5, MA=14-11, RA=12-0, DIS=2-11, VIQ=126, PIQ=129, IQ=131 Intellectual functioning evaluated by WISC improved significantly since last testing. Intertest scatter has decreased.
9/1/66	VA 4	An esophoric trend and magnificant convergence ability and positive ductions characterize his vision pattern. On the other hand, ##11 and 17B are low. Weaker training lenses and probably slight minus for distance vision.

5/28/66	Psych. 3	CA=13-10, MA=15-0, RA=10-2, DIS=4-8, VIQ=87, PIQ=131, IQ=109.
5/16/66	VA 3	"Benefit from training seems minimal. Vision studies about the same, some areas a bit better some worse. Complete passivity. No response, questions, comments, participation from him without a great deal of pressure.
	Psych. 4	CA=14-11, MA=16-5, RA=10-1, DIS=6-4, VIQ=90, PIQ=135, IQ=112
		Still a large discrepancy between WISC Verbal and Performance, but this 45 point difference is probably exaggerated some by practice effect. (P)
9/13/66	VA 4	At no time did he see in aware of how vision training fit into his reading problem. He shows some improvement here and there but his overall vision performance is much the same as when he began with the study. (O)

Case: Experimental I

Sex: Male

4/22/64	Psych. 1	CA=11-3, MA=11-8, RA=8-8, DIS=3-0, VIQ=96, PIQ=111, IQ=104. (No evaluative comments from P)
7/1/64	VA 1	Lack of sound binocularity, which may be due to developmental problems or minimal brain dysfunction. He has fallen on his head frequently and might have had a concussion at age 7. Parents: 2 sibs ages 16 and 8. During pregnancy mother took harmone. She also had kidney stone and fluid at about 6-7 months. Was born with instruments; marked at temples. Best subjects are math, art, and writing. Poorest subjects are reading and French. Repeated second grade because of reading. Daydreams, sensitiveness, restless, temper displays, inattentive, sleep disturbances. overactive.
11/3/65	Psych. 2	CA=12-10, MA=14-0, RA=9-9, DIS=4-3, VIQ=94, PIQ=125, IQ=109. Enthusiastic and diligent.
7/23/65	VA 2	No comments from O.
10/19-12/14/65	RR	15 sessions. His main weakness is in the area of regressions. lack of smoothness in oral reading and insecurity in silent reading. His attitude toward the work was very good and shows a real desire to take advantage of every opportunity to improve. His teacher moved him up to the next highest group in reading. He is beginning to turn into a slow but careful reader and seems to be maintaining his steady improvement gain. Remarks able improvement in achievement and interest.
6/15/66	Psych. 3	CA=13-5, MA=15-2, RA=10-3, DIS=4-11, VIQ=92, PIQ=133, IQ=113. Very cooperative, worked with enthusiasm on Block Design and Object Assembly.
5/29/67	VA 3	No comments from O.
11/28/66	Psych. 4	CA=13-11, MA=16-5, RA=10-0, DIS=6-5, VIQ=103, PIQ=132, IQ=118. (No comments from P)
	VA 4	No record.

Case: Experimental J

Sex: Male

4/21/64	Psych. 1	CA=9-11, MA=12-5, RA=9-10, DIS=2-7, VIQ=124, PIQ=120, IQ=124. His superior ability seems to be hindered by immaturity, emotional factors and some weakness in visual-motor development. (P)
7/22/64	VA 1	A vision problem related to the reading retardation which will probably require vision training and also remedial reading therapy. Parents: two sisters ages 21 and 18. Evidence of some hearing auditory problem at age 5. His best subjects are social studies and science; and his poorest subjects are reading and arithmetic. He writes with his face very close to his work. There are some signs of tension during close work. He daydreams, and is sensitive, inattentive, thumb sucking, feeding problems, nervous, lacks interest in work, imaginative lying, inferiority feelings.
4/21/65	VT	No record.
7/14/65	Psych. 2	CA=11-2, MA=12-10, RA=12-2, DIS=-8, VIQ=114, PIQ=114, IQ=115. Seems to lack attention, concentration, work habits "settledness", and confidence. (P)
	VA 2	No record.
6/14/65- 7/22/65	RR	Good application of phonetic skills to new word attack. Above average vocabulary and comprehension. Poor work habits, hurries through work and resists any effort to get him to re-read for checking purposes. Easily distracted. Flip sense of humor, does not really enjoy reading and persists in choosing technical books.
11/29/65	Psych. 3	CA=11-7, MA= , RA=10-7, DIS= , VIQ-114, PIQ=110, IQ=113. Some insecurity and immaturity. (P)
	VA 3	No record.
10/20/66	Psych. 4	CA=12-5, MA=13-7, RA=14-0, DIS=+0-5 (no disability), VIQ=116, PIQ=97, IQ=108. This IQ score is very likely an under-estimate. He was over confident and handled performance items carelessly. He still seems immature emotionally. (P)
12/30/66	VA 4	No general comments.

Case: Experimental K

Sex: Male

4/24/64 Psych. 1 CA=9-3, MA=10-10, RA=9-0, DIS=1-10, VIQ=120, PIQ=111, IQ=117.

"He played role of an aggressive extrovert during testing. There are no speculative nor known environmental factors to explain any reading underachievement. Does not wear glasses in school." (P)

6/3/64 VA 1 "Shows minus projection in the analytical on Keystone skills...vision is unequal...fails fusion test at distance. I would recommend training and lenses." (O)

Parents: One sister age 12; Grandfather living in home. First walked at 11 months. Five percent loss of hearing in right ear. First had difficulty in reading at end of 1st grade. Best subjects are spelling and arithman. Poorest subject is reading. Changed schools in 1963. Changed teachers frequently in the 2nd grade. Has difficulty in copying from book and chalkboard. Daydreams.

1/4/65-2/25/65 Approximately 14 sessions of VT plus home training.

4/1/65 Psych. 2 CA=10-3, MA=10-9, RA=10-0, DIS=-9, VIQ=111, PIQ=97, IQ=105.

"During the testing, he enjoyed added attention by the examiner. Almost no persistence with constant prodding needed on the more difficult items. In performance area of the evaluation he lacked a definite plan of attack." (P)

4/6/65 VA 2 "Skills have all improved, he is nearing +50 sph. OU for school and all close work. He was very willing to come in for training twice per week. Upon testing...worried if his answers were correct." (O)

4/26/65-6/2/65 RR 21 sessions. He showed little incenative toward wanting to improve. Everything was done because he felt he was being pushed. He does have an eye difficulty that may contribute to his lack of interest in reading. (R)

8/11/65 VA 3 Visually his skills are adequate but he has not been using his lenses since school was out. I do not feel that his parents are as interested in his vision as they were in beginning of the training program. Did not have glasses with him "does not know just where they are now." Might have improved more if there had been more cooperation with home training. (O)

9/29/65	Psych. 3	CA=10-9, MA=12-7, RA=10-5, DIS=2-2, VIQ=114, PIQ=118, IQ=117. "Displayed a high degree of anxiety and some confusion when aware of times subtests. Constantly mumbled to himself when he was unable to find a quick solution to tasks (picture arrangement, block design and object assembly subtests). (P)
6/30/66	VA 4	He shows some general improvement in vision skills, but I do not feel that he has gained as much as we anticipated from visual training. He does not apply himself as most children do during the examination. (O)
7/13/66	Psych. 4	CA=11-6, MA=13-1, RA=10-9, DIS=2-4, VIQ=110, PIQ=115, IQ=114.

Case: Control A

Sex: Male

5/30/63 Psych. 1 CA=9-9, MA=10-7, RA=8-5, DIS=2-2, VIQ=95, PIQ=122, IQ=104.

He wears glasses which seem to bother him so he wears them intermittently. His self-discipline is weak, as is his academic drive. He is the youngest of 3 brothers, nervous...short attention span... poor motor coordination. (P)

7/15/63 VA 1 VT recommended for an estimated 8-12 weeks, followed by remedial reading. He is jittery, but he tries to cooperate...good visual acuity with or without lenses, but he needs plus lenses near and far. He has poor body coordination and shows a number of reversals. He over converges on skills; and shows poor near to far fixations. Lenses also recommended. (O)

Parents: He has a tendency to be slow, and complains of blurring. He won't wear glasses, and confuses words that look similar. Discouraged, sensitive, quarrelsom, temper displays, sleep disturbances.

3/16/64 Psych. 2 CA=10-6, MA=12-2, RA=9-1, DIS=3-1, VIQ=113, PIQ=117, IQ=116.

Seldom wears glasses, but his ability to concentrate is improving, especially when working alone at his own level. His achievement is still erratic, but he has a greater desire to please. (P)

3/19-26/64 VA 2 Many facial distortions, and once burst out: "I can't do it." He uses delaying tactics to stay out of school. (O)

8/29/64 VA 3 Some mixing of capitals and small letters. (O)

9/14/64 Psych. 3 CA=11-0, MA=11-1, RA=9-9, DIS=1-4, VIQ=86, PIQ=118, IQ=101

Seemed sleepy the entire time, but came alive on performance tests. (P)

10/15/65 Psych. 4 CA=12-2, MA=11-5, RA=9-1, DIS=2-4, VIQ=85, PIQ=106, IQ=94.

He worked diligently with little apparent fatigue. He even whistled on the performance test. (P)

10/18/65 VA 4 He is having difficulty reading above the 3rd grade level. His comprehension is poor and he avoids reading. His eyes water and he rubs them when placed under near point activity for more than 2-3 minutes. (O)

Case: Control B

Sex: Male

6/14/63	Psych. 1	CA=10-7, MA=10-8, RA=9-3, DIS=1-5, VIQ=96, PIQ=103, IQ=101. He says he has a bad temper, but he seemed to enjoy talking. He seldom guessed at items that he did not know, and seldom tried when he could not feel that success was possible (P)
7/16/63	VA 1	His problem appears to be very poor coordination between large and small muscles and very poor directionality. He reports small headaches in mornings and some vision blurring. VT recommended. (O) Parents: He is sensitive to reactions of other children. He repeated kindergarten. He is the middle child of 4 sisters. First walked at 11 months and was clumsy as a child. Hemangioma at birth and many falls when small, all on his head. Best subject is writing and poorest subject is reading. He has headaches at top of head--lasts between 2-4 hours. Sensitiveness, quarrelsome, restless, inattentive, nail biting, sulky, over-critical, ridicules others, nervous, inferiority feelings.
3/31/64	Psych. 2	CA=11-4, MA=11-5, RA=10-3, DIS=1-2, VIQ=96, PIQ=106, IQ=101. Friendly and cooperative during testing. He spoke in a quiet, breathy tone, and seldom engaged in spontaneous talk. IQ score same as in June 1963. (P)
5/13/64	VA 2	No written comments.
9/30/64	Psych. 3	CA=11-10, MA=12-5, RA=11-2, DIS=1-3, VIQ=96, PIQ=114, IQ=105. Much more relaxed, conversational and friendly. He spoke in a soft voice, and exhibited constraint and self-control. (P)
10/16/64	VA 3	No written comments.
1/29/65	RR	38 sessions. He was willing to cooperate at all times, courteous, and punctual. Has read mostly on sixth grade level. (R)
10/1/65	Psych. 4	CA=12-10, MA=14-1, RA=11-10, DIS=2-3, VIQ=100, PIQ=117, IQ=109. Testing conditions were not very quiet. Better rapport this time than in previous sessions. He is more conversive, relaxed, and friendly. (P)
10/8/65	VA 4	He complains he still cannot read well and that he lost his glasses. (O)

3/18- 5/14/66	RR	37 sessions with a remedial class. On Gates (4.3) showed 7 months gain. He was immature and exitable, but now has quieted down. He is expected back in "Reading Room" in the fall. Glasses are bifocals which he cannot seem to adjust to. On 5/18, he agreed to leave them in the teacher's desk for use just with reading.

Case: Control C

Sex: Male

8/15/63	Psych. 1	CA=9-9, MA=11-3, RA=9-1, DIS=2-2, VIQ=114, PIQ=111, IQ=115. He wears heavy glasses, has considerable humor, and a happy-go-lucky approach to life. (P)
10/14/63	VA 1	He gets headaches when doing homework that lasts several days. He reports a problem remembering what he has read. VT recommended.
		Parents: Two sibs ages 14 and 16. Mother had taxemia during delivery. He did not crawl--just got up and walked. Heart murmur...disappeared. Previously diagnosed myopia, and now wears glasses all the time. Sensitiveness, restlessness, overactivity, and quarrelsome at times.
6/15/64	Psych. 2	CA=10-7, MA=13-3, RA=10-8, DIS=2-7, VIQ=115, PIQ=132, IQ-125. He has high-average intelligence and seems to be functioning quite well in all areas. (P)
5/18/65	VA 2	No written comments.
10/6/64-1/26/65	RR	22 sessions. He shows little interest in himself or work. Has an "I don't care-why should I?" attitude, and at times, seems to crave attention. He is improving nicely.
2/12/65	Psych. 3	CA=11-3, MA=14-1, RA=12-1, DIS=2-0, VIQ=118, PIQ=129, IQ=125. His test scores are almost identical to scores from the last administration).
10/29/65	Psych. 4	CA=12-0, MA=14-5, DIS=1-11, VIQ=109, PIQ=128, IQ=120. No written comments.
	VA 3 and VA 4	No records.

Case: Control D

Sex: Female

6/14/63 Psych. 1 CA=9-7, MA=11-9, RA=10-4, DIS=1-5, VIQ=118, PIQ=125, IQ=123. A very sober little girl, but quite straight forward in her work. She is left handed but managed her papers in the proper orientation.

7/6/63 VA 1 VT recommended. She has some difficulty in pursuits, saccadics accommodative facility and fusion. However, form perception is excellent. She complains of eyes hurting after 5 pages of reading, and on looking from board to book and back again. These are probably related to her difficulty in ocular motor control and prevent her from obtaining more extensive reading experience.

She tends to be shy with a strong desire to please and be accepted. She cooperated very well on all tests. However, I believe that while she will become an adequate reader without visual training, nevertheless some visual training and study glasses would be of benefit in allowing her to reach a higher level. There is the possibility of her developing a myopic adaptation as a result of forcing vision to achieve in reading if training is not given.

Parents: 2 older sisters. Walked at 12 months. She has had difficulty with reading from the start. Her best subjects are language, spelling, penmanship, and her poorest subjects are arithmetic, social studies, and science. During grade 4, she had remedial tutoring. She complains of her eyes hurting after reading 5 pages. She seems to need to re-read in order to comprehend. Shyness; sensitive; and fearful.

3/16/64 Psych. 2 CA=10-4; MA=11-8; RA=11-4; DIS=-4; VIQ=104; PIQ=121; IQ=113.
She was frightened because she was called to principal's office (for testing) without an explanation. She was non=communicative.

3/29/64 VA 2 No written summary statements.

12/16/64 Psych. 3 CA=11-1; MA=13-0; RA=11-7; DIS=1-5; VIQ=106; PIQ=127; IQ=117
Her performance showed some practice effect. She has matured markedly since the study was initiated.

2/7/65 VA 3 No written summary statements.

6/2/65 RR 18 half-hour sessions. She showed substantial improvement in reading skills for this year. (R)

11/5/65	Psych. 4	CA=12-0; MA=13-7; RA=13-7; DIS=0; VIQ=101; PIQ=124; IQ=113. Consistent on performance items, but showed marked variability on verbal scale tests. She is still subdued, reticent, and gives the appearance of having no self-confidence whatsoever. (P)
11/19/65	VA 4	She follows instructions nicely. She shows signs of eyestrain that result from reading. She seems well motivated to read. (O)

Case: Control E

Sex: Male

8/2/63	Psych. 1	CA=10-0, MA=10-2, RA=8-2, DIS=2-0, VIQ=105, PIQ=99, IQ= 102. He appeared nervous throughout testing, continually twisting his hands and chewing his nails and knuckles. He responded well to questions except for answering very slowly and giving up quickly on more difficult questions. (P)
9/6/63	VA 1	VT recommended for estimated 10-12 weeks. He is a hyperope with esophoria. He seems quiet, almost withdrawn. His eyes were never fully open. He should show a marked improvement in writing and reading skills following proper vision and remedial reading therapy, although I am not positive I can shake this boy loose from his present apathy. (O) Parents: No siblings. He walked at age 1-0, had measles about age 6-0 when his temperature went to 104°. His best subjects are science and spelling and his poorest subjects are reading and writing. He complains of headaches with nausea sometimes and says his eyes get tired when he reads after school. Daydreams; discouraged sometimes; inattentive; lacks interest in work; and has some tics, muscle twitching, and fidgeting.
3/10/64	Psych. 2	CA=10-7, MA=12-2, RA=10-2, DIS=2-0, VIQ=109, PIQ=120, IQ=115. There were no personality or emotional problems indicated. He was calm throughout the test and attempting to do his best on all parts of the test. (P)
3/26/64	VA 2	No written summary statements.
3/10/65- 4/23/65	RR	30 sessions His vocabulary is good but he lacks motivation.
5/14/65	Psych. 3	CA=11-9, MA=12-0, RA=10-10, DIS=1-2, VIQ=109, PIQ=113, IQ=112. He is now working one year below grade level in reading. No personality or emotional problems were indicated. (P)
5/21/65	VA 3	Still holding on to his distant acuity--but barely. (O)
10/28/65	Psych. 4	CA=12-3, MA=13-7, RA=10-8, DIS=2-11, VIQ=100, PIQ=121, IQ=111. Same as before (remarks)

11/15/65 VA 4	Lethargic in some ways. He appears to be receptive to plus lenses. He might be helped even at this later stage, with lenses and VT. (0)

Case: Control F

Sex: Female

8/15/63	Psych. 1	CA=9-6, MA=9-5, RA=8-5, DIS=1-0 VIQ=95, PIQ=103, IQ=99. On the Bender Gestalt, she counted the number of dots right to left in the drawing. (P)
9/30/63	VA 1	VT recommended. She bites on lower lip, often throughout the procedures. She is a hyperope with esophoric tendencies. Visually seems to be trying too hard. She is tightly centered on her near task to the point of losing the surrounding areas. Overall, response to plus is favorable. (O) Parents: 3 brothers, ages 8, 5, and 2. Walked at 1 year. She had convulsions when running high fever at 15 months which started right ear drum damage. Poorest subjects are reading and spelling She complains of eyes burning and itching and she needs to re-read to comprehend. She is unable to remember what has been read.
3/10/64	Psych. 2	CA=10-1, MA=9-2, RA=9-8, DIS=+6 months (no disability), VIQ=90, PIQ=103, IQ=96. No personality or emotional disturbance is indicated. (P)
3/31/64	VA 2	She has a pleasing, warm personality, and is quietly cooperative. She is visually pulling in. (O)
4/10/65- 4/23/65	RR	30 sessions. She has worked very hard but her vocabulary is limited. (R)
5/11/65	Psych. 3	CA=11-3, MA=11-2, RA=9-9, DIS=1-5, VIQ=97, PIQ=104, IQ=101. Comments the same as previous testing.
8/21/64	VA 3	Appears a quiet resigned youngster. Does not smile or laugh easily in office. (C)
12/4/65	Psych. 4	CA=11-10, MA=12-5, RA=10-3, DIS=2-2, VIQ=96, PIQ=114, IQ=105.
11/19/65	VA 4	She is content, more sure of self. Visually, she seems to be adapting to her problem.

Case: Control G

Sex: Male

4/15/64	Psych. 1	CA=10-1, MA=11-9, RA=9-5, DIS=2-4, VIQ=108, PIQ=125, IQ=117. No comments from P.
8/11/64	VA 1	One characteristic which stands out...severe tension. Parents and child convinced eyes have nothing to do with reading. An immediate and positive response was evoked in most instances when plus was applied. VT recommended with some questions. (O) Parents: Never taught to sound words. 6 sib, ages 21 to 4; first walked at 10 months, was clumsy; likes baseball; "We make him go to library where he will read books." Pneumonia at age 2, hospitalized for 7-10 days; stuttered and still does a little; best subjects are math and spelling; poorest subject is reading; was put in slow reading group within normal grade; skips and re-reads lines; loses place; slow reading and word calling; does not remember what he reads; daydreams; shy; restless; destructive with toys; inattentive; untruthful; nervous; lacks interest in work; has tics, muscle twitching, fidgeting, and is boastful.
7/16/65	Psych. 2	CA=11-4, MA=12-4, RA=9.9, DIS=2-7, VIQ=104, PIQ=114, IQ=109. No unusual behavior noted except inclination to emphasize speed over accuracy. (P)
9/24/65-4/66	RR	Enrolled in school's Reading Center.
9/15/65	VA 3	Less tense than when seen before. Visual problem becoming eye problem. Plus much less effective now, supplied with some minus shortly. (O)
5/28/66	Psych. 3	CA=12-2, MA=14-3, RA=9-8, DIS=3-7, VIQ=113, PIQ=120, IQ=117. No comments from P.
5/16/66	VA 3	Nice progress in school. Visually he is efficient much more so than 2 years ago. His myopia is not overly restricting at this time. (O)
8/2/66	VA 4	Entire case seems more stable and better in balance, but no really big change since May. The minus is not increasing, and the same Rx now allows him greater latitude of performance. (O)
8/22/66	Psych. 4	CA=12-5, MA=14-3, RA=10-3, DIS=4-0, VIQ=103, PIQ=125, IQ=115. May score higher, if he elaborated on verbal responses; he hesitates to respond if he is not sure of being correct. (P)

Case: Control H

Sex: Male

4/2/64	Psych. 1	CA=10-10, MA=10-3, RA=8-5, DIS=1-10, VIQ=92, PIQ=99, IQ=95. He seems passive (a "family trait"?), cooperative, and shy. (P)
	VA 1	Poor binocularity and poor perceptual ability. Visual training should result in a more efficient perceptual mechanism. VT recommended. (O)
		Parents: 3 siblings, ages 15, 13, and 7. He is good at baseball and poor at basketball. He rolls back and forth in his sleep. His best subject is arithmetic and his poorest subject is reading. He repeated 1st grade because of difficulty in learning to read. Easily distracted, he daydreams a lot, and shows considerable shyness.
11/4/65	Psych. 2	CA=12-5, MA=11-7, RA=10-0, DIS=1-7, VIQ=82, PIQ=106, IQ=93. He is very vague and uncertain of himself in his approach to answers and solving problems. He is not very sure what is expected of him. He needs clear concise directions and much support. (P)
10/19- 12/14/65	RR	15 sessions His attitudes appear worse than they really are although it will take time for him to realize that he is rather a nice boy and can be a fair scholar if he tries. His classroom teacher has moved him from the "early group" to a higher group. This kind of attention seems to "set him up". For example, he came in the room intending to win one of our contests, and he did. On the McCall Crabbs, he scores 5.3. He is a restless happy-go-lucky child. (R)
6/15/66	Psych. 3	CA=13-0, MA= , RA=10-10, DIS= , VIQ=87, PIQ=108, IQ=97. He was cooperative. It is felt that this is an accurate appraisal of his abilities. (P)
	VA 3	No records.
11/7/66	Psych. 4	CA=13-5, MA= , RA=9-2, DIS= , VIQ=85, PIQ=106, IQ=94. His feelings of inadequacy tend to destroy his efforts to do well. His ego development has been greatly impaired by failure. (P)
6/3/67	VA 4	No summary observations.

Case: Control I

Sex: Male

	Psych. 1	CA=10-9, MA=12-3, RA=8-7, DIS=3-8, VIQ=104, PIQ=122, IQ=114. Believed to be a valid estimate. Retained in second grade because of poor work habits. Work style now is meticulous, methodical. Does not seem to be highly motivated toward academic work. (P) VT recommended.
6/3/64	VA 1	His vision problem is related to the reading retardation which means that he will probably require vision training and also remedial reading therapy. (O) Parents: 2 sibs, ages 13 and 7. First walked at 11 months. Highest body temperature was 103°. His best subjects are art, music, and science, and his poorest subjects are reading and writing. He has had difficulty in reading from start. He repeated 2nd grade and he changed schools twice because of family moves. He has an unusual posture while writing and he also tilts his head. He dislikes reading and reading subjects. Sometimes he needs to re-read in order to comprehend and he lose his place while reading. Sometimes he cannot remember what he has read. Daydreams; restless; temper displays; sulky; feeding problems; sleep disturbances; nervous; tics, muscles twitching, fidgeting.
3/31/65	Psych. 2	CA=11-9, MA=11-4, RA=9-11, DIS=1-5, VIQ=97, PIQ=113, IQ=105. He is rather nervous and insecure when confronted with difficult items. (P)
3/30/65	VA 2	He seems more shy now than before. He says chalkboard is blurry now from the back of the room. He is deeper in myopia now. Lenses recommended now for him. (O)
9/29/65	Psych. 3	CA=12-3, MA=14-4, RA=9-7, DIS=4-9, VIQ=101, PIQ=132, IQ=117. In comparison with other performance subtest scores his speed on coding appears to have been impeded by his left-handedness. (P)
4/27- 5/26/65	RR	17 sessions. Not too much progress was made. When he reads orally he has so many regressions that I am sure vision training is needed. (R)

8/4/65	VA 3	He is complaining of blurred vision now at distance, especially in school. I am giving him a correction for use in school and T.V. He seems very quiet and withdrawn. I know nothing of his home life or have not met his parents. (0)
7/14/66	Psych. 4	CA=13-0, MA=14-11, RA=8-8, DIS=6-2, VIQ=96, PIQ=132, IQ=115. No comments from P.
6/30/66	VA 4	He shows some sypression areas, also more myopia than one year ago. He says he can see ok with his present glasses. His right eye is more blurred. (0)

Case: Control J

Sex: Female

4/22/64	Psych. 1	CA=9-10, MA=11-11, RA=9-4, DIS=2-7, VIQ=119, PIQ=120, IQ=121. Her drawing indicates that she is immature emotionally. Her emotional involvement shows a need for maternal attention especially, yet she is socially mature. Ability is in the low superior range. (P)
7/29/64	VA 1	Significant refractive error, poor pursuits and saccadice, poor binocular pattern. VT recommended. Parents: 2 siblings, ages 11 and 9. At child birth, there were complications before delivery. Has had head and eye inquries; has had paint sprayed into eyes and stitches for a cut in her head. Her best subjects are spelling, art and arithmetic and her poorest subject is reading. She has had glasses prescribed to wear when reading and watching T.V. Rubs eyes excessively; sensitiveness; restless; temper displays; untruthful; disobedient; thumb sucking; nervous; imaginative.
6/14- 7/22/65	RR	26 sessions. Word attack skills are adequate although she frequently fails to use them in multisyllable words. She has shown decided growth in the use of context clues. She is weak in recognition and interpretation of words with multiple meanings and in selecting the important facts to remember...arranging ideas in sequence. Oral reading is marred by too rapid reading and lack of expression.
7/13/65	Psych. 2	CA=11-1, MA=12-10, RA=11-4, DIS=1-6, VIQ=110, PIQ=117, IQ=115. She was disheveled and not too personally appealing. Her behavior was independent, distant, and worked hurriedly but cooperatively. (P)
11/23/65	Psych. 3	CA=11-5, MA=13-2, RA=10-7, DIS=2-7; VIQ=110, PIQ=117, IQ=115. Pleasant and cooperative but reserved and quiet. (P)
5/18/66	VA 3	No comments by O.

10/22/66	Psych. 4	CA=12-4, MA=14-1, RA=11-6, DIS=2-7, VIQ=100, PIQ=129, IQ=115. Personality problems seem to interfere with her ability to function at this level. (P)
1/11/67	VA 4	No comments by O.

Case: Control K

Sex: Male

4/23/64	Psych. 1	CA=10-2, MA=14-0, RA=9-7, DIS=4-5, VIQ=130, PIQ=137, IQ=138. Seems to be a well-rounded healthy youngster whose social potential for adjustment and integration matches his intellectual potential. He is literally bored by his curriculum. Comes from an upper socio-economic family, and it is a shame that interest in the more mundane activities (homework) have not been encouraged as they might have. His teacher reports performance has increased significantly...still not working even close to his potential. (P)
6/4/64	VA 1	He is failing fusin at distance and difficulty holding at near. Sypression is evident in pointers and drawings. I would recommend training with plus lenses. (O)
		Parents: 3 sibs, ages 17, 12, 8. Entered kindergarten at age 4 1/2. Has had difficulty in reading from the start. His poorest subject is reading. He repeated 2nd grade. Daydreams; discouraged; sensitiveness; restless; fearfulness; nervous; inferiority feelings.
3/30/65	VA 2	He is still not fusing distance and rear is slow. (O)
3/31/65	Psych. 2	CA=11-1, MA=13-6, RA=10-4, DIS=3-2, VIQ=114, PIQ=127, IQ=122. Seems to enjoy competition in the classroom, but is not at the top of his class. This estimate appears to be valid. (P)
4/26- 6-2/65	RR	24 sessions. Has made most progress of the three students in class. He made the biggest gains in attitude toward reading.
8/4/65	VA 3	Usual vision at near is better; his #19 is lowered somewhat as well as accommodation facility. (O)
9/28/65	Psych. 3	CA=11-7, MA=15-5, RA=10-7, DIS=4-10, VIQ=124, PIQ=136, IQ=133. No comments from P.
6/28/66	VA 4	J. seems to have adequate visual skills. Very alert and interested. (O)
7/14/66	Psych. 4	CA=12-5, MA=15-5, RA=10-5, DIS=5-0, VIQ=111, PIQ=133, IQ=124.

APPENDIX B

THE DEVELOPMENT OF PERCEPTUAL REORGANIZATION SKILLS

by

Jean Buckley Aurand, M. A.

INTRODUCTION

Statement of the Problem

Visual perception is one of the fundamental processes involved in reading. Reading, as it is commonly practiced, necessitates perceiving the printed letter or word. Before a child can perceive printed shapes he must be able to perceive small meaningless shapes containing a good deal of detail.[1] A few systematic investigations of the development of shape and pattern perception have been carried out. Vernon[2] has provided an extensive summary of these studies.

Reading consists not only of fine perceptual discriminations between visually similar letters, such as b and d or m and n; it also involves an awareness of their orientation in respect to other letters. The ability to recognize essential elements within words and possibly figures, and then reorient them correctly, may well be a perceptual ability important for reading.

Many of the studies regarding word recognition in children show results which are speculative and inconclusive.[3] Studies have shown that children recognize words by beginning letters, final letters, trivial details such as the dot over the i, general shape, length, similar ascending or descending letters, etc.[4]

It is possible to reconcile these findings with the assumption that children perceive general structure but neglect detail. It may be that a child perceives words as unanalyzable wholes with their shapes characterized by the shapes of certain particular letters.[5]

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[1] M. D. Vernon, Backwardness in Reading, Cambridge University Press, London and New York, 1957, p. 8.

[2] Ibid., pp. 9-13.

[3] Ibid., p. 22.

[4] Ibid., p. 23-24.

[5] Ibid., p. 25.

Condensed by Chas. B. Huelsman, Jr., from a Thesis presented in partial fulfillment of the requirements for the Degree Master of Arts, The Ohio State University, 1964.

A test of perception (especially one which requires the analyzing out of the important parts of a configuration and reorienting those parts appropriately as is required for reversing a figure) should test perceptual reorganization skills.

Being able to perceive small shapes and to distinguish similar but slightly different figures (letters) from each other is essential to reading. Previously learned perception is a necessary prerequisite if a child is to learn to perceive in reading.

Although the development of some perceptual skills has been studied, no one has considered the skill involved in the reorganization of a percept (as in drawing a reversed figure).

The ability to recognize essential elements within figures and to reorient them correctly is conceivable a perceptual ability that may be important for reading. There are, however, no studies to be found which test such an ability. It became the purpose of the present study to discover and evaluate a test of perceptual reorganization as a first step in determining the importance of such a skill in relation to reading and school achievement. It also became possible, once the Form 11 test was located, to discover the influence of some variables upon the score, and to consider the relative value of such of the scores.

The questions to be answered by the study were:

1. Is the Form 11 test of perceptual reorganization reliable?

2. How do sex and grade influence the growth curve of perceptual reorganization skills as measured by the Form 11 test?

3. Is there a significant decrease in the difference between the number of figures drawn correctly as presented and the number drawn correctly reversed with increase in grade?

4. Is there a decrease in total time taken to perform the Form 11 test with an increase in grade?

5. Is there a significant decrease in the difference between the time taken to draw the figures as presented and the time taken to draw the figures reversed with increase in grade?

PROCEDURE

Selection of Subjects

The community of Reynoldsburg, Ohio, which has a population of

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[4] Ibid., p. 23-24.
[5] Ibid., p. 25.

of 11,090 and a school population of 3,705 was chosen as the district in which to gather data. Reynoldsburg is a suburban community located in Truro Township of Franklin County, Ohio. It houses a wide range of income groups. Average income per household in Truro Township as of January 1, 1964, was $8,316.00.[6]

Out of a total of 1501 first through fourth graders, thirty boys and thirty girls from each of grades one, two, three and four, a total of 240 children, were selected randomly according to a method described by Yates.[7] It was believed that a sample of 60 was sufficiently large to yield stable results.

Selection of Test

A test suggested by Nathan Flax,[8] consisting of eight figures graduated in difficulty, was chosen. The Form 11 test first requires the child to copy each figure as it is seen. The child is then instructed to copy each figure backwards. He is timed in seconds in each direction. It was felt that such a test would measure perceptual reorganization, since in order to reverse a figure it is necessary to select the significant parts and reorient them in direction. Since elapsed time was recorded, the ease or difficulty a child had with the reorganization task may be inferred.

Since the Form 11 test is short and since it was desirable to check reliability, an alternate form of the test was devised which consisted of the original forms in an inverted position. The alternate form was called Form B and the original form was designated Form A. Copies of each test are included. Both Form A and Form B of the test were administered to each child individually. The forms were alternated in the order in which they were presented so that practice effect could be controlled.

A work card was used as the record of the scores for each child. On it space was provided for number correct forward, number correct reversed, the difference between the scores, time in seconds forward, time in seconds reversed, and the difference between the time for Forms A and B of the test. Space was also provided for identifying data and a designation of AB or BA identifying which form of the test was administered first. The designation AB or BA was assigned to each child before testing began to insure that half of the boys and half of the girls in each grade would take Form A first and half would take Form B first.

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[6] "Public Affairs Page," Columbus, Ohio Chamber of Commerce, 1964 mimeo.

[7] Frank Yates, Sampling Methods for Censuses and Surveys, (3rd ed.) Hafner Publishing Co., 1960, pp. 21-23.

[8] Nathan Flax, O. D., took his training at Columbia University School of Optometry. He is now in private practice restricted to vision training in Garden City, New York. He serves as a consultant to the Optometric Center of New York City. He is a Fellow of the American Academy of Optometry.

Administering the Test

The following directions for administering the test were used:

DIRECTIONS

Give S a pencil without an eraser.

Say to the child:

> Copy this drawing (point to first one) here (point to the middle space). Then do the others on this page and on the next page in the same way.

Record elapsed time for the 8 drawings in seconds. Then say to the child:

> In this space (third space) copy this (first) drawing backwards (L-R reversal). Then do the others on this page and on the next page in the same way.

Record elapsed time for the 8 drawings in seconds.

If a subject hesitated or otherwise gave indication of not understanding the second task, the direction was repeated and modified by saying:

> Copy this drawing and make it look backwards.

Scoring the Test

The following criteria was used for scoring.

Figure 1: Figure 1 is counted correct if the line is at approximately the same angle as the stimulus line. Length of the line is not a factor. When the line is drawn near the middle of the box, the corner may be used as a reference point. The line should not point to the lower left corner or above the corner. Except for this one restriction, any line with an obvious slant is counted correct. The same is true for the reverse figure. Figure one is scored leniently.

Figure 2: Figure 2 is scored leniently. It must be reasonably straight in the box provided, and the angle must be obviously obtuse. The relative lengths of the lines are not considered unless the angled line equals or exceeds the length of the vertical line, in which case the figure is incorrect.

Figure 3: The figure must be properly oriented in the box and the

angle visually similar. An angle larger than 60 degrees or less than 45 degrees makes the figure wrong. These angles may be approximated visually. The relative lengths of the legs is considered only if the horizontal leg is less than one half the length of the diagonal one, or if the angled leg is less than one third the length of the horizontal one. Figure 3 is scored leniently.

Figure 4: The figure must be properly oriented in the box. The angled line must not cross at a corner of the figure. The other vertical and horizontal lines must approximate right angles to each other and the angled line must not appear parallel to any of the other lines. The shorter leg of the figure must be obviously shorter than the longer leg.

Figure 5: Figure 5 is scored leniently. It must be properly oriented in the box. The curved line must approximate a half circle. Figure 5 is often drawn more like a C or G, which is an error. The half circle and the vertical line must meet at a point "angularly."

Figure 6: The figure must have a vertical line with a diagonal across it. It should not look like an X.

Figure 7: There are many points to check in Figure 7. The figure must be properly oriented in the box. The curve must be in the proper direction and must not hook back down. The horizontal line must be reasonably straight and at an apparent right angle to the vertical line. The angled line should not enclose an angle of more than 45 degrees with the vertical line, and the rectangle should appear as an obvious rectangle (not a square or parallelogram), have four corners, and be approximately perpendicular to the angled line. The relative sizes of the parts are judged leniently.

Figure 8: The figure is judged strictly. It must be properly oriented in the box. Each successive angle must appear less acute than the preceding one, the bottom one being approximately a right angle. Relative lengths of the lines are also considered. They must appear visually in the same proportion as the stimulus figure

Treatment of Data

The data for each subject were tabulated on a work card. Because of the complexity in arranging the data for the computations, the data were transferred to work sheets from which IBM cards could be punched. All of Test A and Test B data were arranged so that coefficients of correlation could be obtained. The data were also organized so that data from the first test given could be compared with data from the second test given. After these correlations were obtained, the pertinent information from Test A on the IBM cards was used for the analysis of variance.

It was only necessary to use data from one form of the test to compute an analysis of variance. Test A was selected.

FINDINGS

Question One: Is the Form 11 test of perceptual reorganization reliable?

The data were first analyzed for reliability between the two forms of the test.

TABLE A1

Coefficients of Correlation Between
Form A and Form B

Number correct forward	.639 **
Number correct reversed	.655 **
Difference between forward and reversed correct	.146 *
Time forward	.529 **
Time reversed	.658 **
Difference between time forward and reversed	.495 **
Total correct	.772 **
Total time	.617 **

* Significant at .05 level
** Significant at .01 level

The coefficient of correlations indicated that Forms A and B of the test tend to measure the same ability. All of the correlations except the difference between number of correct figures forward and reversed are significant at the .01 level.

Because practice and familiarity with a task can affect performance, the means of the first test given were compared to those of the second test to determine practice effect. The means showed that practice did not affect the mean number forward and reverse.

TABLE A2

Comparison of Means of First Test Given
With Means of Second Test Given

	First Test	Second Test
Number correct forward	5.0	5.0
Number correct reversed	3.0	2.9
Time forward	64.9	51.8
Time reversed	90.7	82.2

The evidence indicates that number right scores have some reliability although not enough for use in predicting the skill of individuals.

Question Two: How do sex and grade influence the growth curve of perceptual reorganization skills as measured by the Form 11 test?

To answer Questions Two and Three, a repeated measures analysis of variance[1] was applied to Form A test data to determine the effects of grade and sex on the scores and the interactions of grade with sex, direction (forward or reversed) with sex, direction with grade, and direction with grade and sex.

TABLE A3

Analysis of Variance
Number Correct

Source	df	Mean Squares	F Ratio
Between Subjects	239		
Grade	3	51.77	13.81 **
Sex	1	15.41	4.11 *
Grade/Sex	3	2.05	.55
Subjects within group	232	3.75	

** Significant at .01 level

* Significant at .05 level

Boys received higher scores than girls on the test, the difference being significant at the .05 level. Grade had an effect on scores which was significant at the .01 level. To determine which differences were significant, the Duncan Multiple Range Test was used. The Duncan Test indicated that there were differences significant at the .01 level between the first and fourth grades and between the second and fourth grades. In other words, children in the fourth grade did significantly better than children in either the first or second grades.

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[1] J. C. Naylor and Carol Estep, "An Analysis of Variance Program for Replicated or Non-replicated Designs." Columbus, Ohio, Laboratory of Aviation Psychology, Dittoed.

The interaction between grade and sex was not significant. Neither were there any significant differences in the within subjects analysis. The significance of the difference between number correct forward and number correct reversed with increase in grade were also analyzed. There were no significant differences.

TABLE A4

Mean Number Correct By Grade

	Forward	Reverse
Grade 1	4.38	2.10
Grade 2	5.10	2.46
Grade 3	5.15	3.10
Grade 4	6.67	3.53

Boys performed somewhat better than girls on the test (.05 level). Performance for both boys and girls improved significantly between the first and fourth grades and between the second and fourth grades.

Question Three: Is there a significant decrease in the difference between the number of figures drawn correctly as presented and the number drawn correctly reversed with increase in grade?

The difference between the number drawn correctly forward and the number drawn correctly reversed did not decrease significantly with increase in grade. (The difference score was also relatively unreliable.)

Question Four: Is there a decrease in total time taken to perform the Form 11 test with increase in grade?

To answer Questions Four and Five, an analysis of variance[4] was applied to Test A data to determine the effect of grade and sex on time taken to complete the test. There was a significant decrease in time with increase in grade. To test which differences were significant, a Duncan Multiple Range test was used. The results demonstrated that the differences in time between the first and fourth grades were significant at the .01 level.

There were no significant differences by sex for time taken to perform the test.

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[4] Naylor and Estep, op. cit.

TABLE A5

Mean Number Correct Forward and Reversed by Grade

BOYS

	Mean Forward	S.D.	Mean Reverse	S.D.	Mean Total
Grade 1	4.60	1.7	2.20	1.4	6.80
Grade 2	5.50	1.5	2.76	1.4	8.26
Grade 3	5.30	1.6	3.26	1.9	8.56
Grade 4	6.00	1.3	3.73	1.7	9.73

GIRLS

	Mean Forward	S.D.	Mean Reverse	S.D.	Mean Total
Grade 1	4.16	1.4	2.00	1.3	6.16
Grade 2	4.73	1.6	2.07	1.6	6.80
Grade 3	5.00	1.7	3.07	1.7	8.07
Grade 4	6.13	1.4	3.33	1.8	9.46

TABLE A6

Analysis of Variance of Time

Source	df	Mean Squares	F Ratio
Between subjects	239	12483.33	
Grade	3	12483.33	9.16 **
Sex	1	371.01	---
Grade / Sex	3	893.48	---
Subjects within group	232	1362.03	

** Significant at .01 level.

The significance of the difference between time forward and time reversed as a function of grade and sex was also analyzed. There were no significant differences.

There is a decrease in total time taken to perform the test with increase in grade which is significant at the .01 level. The decrease is significant only between the first and fourth grades.

Question Five: Is there a significant decrease in the difference between the time taken to draw the figures as presented and time taken to draw the figures reversed with increase in grade?

There is no significant decrease in the difference between time taken to draw the figures forward and reversed with increase in grade.

SUMMARY

Visual perception has been the focus of many studies. Tests such as the Bender Visual-Motor Gestalt Test and the Frostig Test of Visual Perception have attempted to show its development. However, no studies were located which measure perceptual reorganization. Because reading involves the perception of relatively few symbols (letters) reorganized into countless different patterns, the development of perceptual reorganization skill could have a relationship to reading. The purpose of the present study was to obtain evidence regarding measurement and development of such a skill.

A test which requires the copying of eight figures in regular and reversed form was selected to measure perceptual reorganization skill. The test was administered individually to a random sample of 240 boys and girls, thirty of each in grades one through four in the Reynoldsburg, Ohio public schools. Form A of the test was administered first to half of the subjects, and Form B of the test was administered first to the other half to control for practice effect. The scores were then correlated and an analysis of variance was computed to obtain answers to five questions.

CONCLUSIONS

1. The test is reasonably reliable for such a short test. However, it is not reliable enough for individual prediction.

2. Grade and sex are factors which influence the growth curve of perceptual reorganization skills as measured by the Form 11 Test. Boys performed somewhat better than girls on the test. Both boys and girls performed significantly better with increase in grade.

3. The difference between the number drawn correctly forward and the number drawn correctly reversed did not decrease significantly with increase in grade.

4. There is a significant decrease in total time taken to perform

the figures with an increase in grade.

5. There is no significant change with increase in grade in the difference in time taken to perform forward and reversed figures.

DISCUSSION AND IMPLICATIONS

It seems likely that the test used in this study tested perception more than perceptual reorganization. While the number of reversed figures drawn correctly improved with grade, the improvement was very similar to the improvement in the number of figures drawn correctly as presented. The ability to reorganize figures may be developed by the time a child is in the first grade or may not be developed until after grade four or may not be reflected by performance on the test selected. If the test measures perceptual reorganization, then both perception and the ability to reorganize the significant parts of a figure appear to develop together.

There is a question about whether the concept of backwards was at least a part of what was being tested. Some children did not seem to know whether it was the figure or their pencil movement that should be reversed. However, it often seemed that the children who had trouble understanding what was required were also the ones who had the most trouble reversing the figures. This difficulty might be alleviated by modifying the directions so as to use practice figures to insure understanding of the task.

There is no ready explanation for the superiority shown by boys on the test. It may be a factor which is statistically significant but is of no practical importance. It could also be a function of this particular sample of children.

The reliability of the Form 11 test is remarkably good for such a short test. It could probably be further improved, however, by lengthening the test.

While the difference in amount of total time taken to perform the test with increase in grade was significant at the .01 level, it was significant only between the first and fourth grades. To the extent that it is a measure of the facility with which a child can perform the perception and perceptual reorganization task, time used to perform the test could have an important relationship to reading.

SUGGESTIONS FOR FURTHER RESEARCH

1. The Form 11 test should be lengthened to improve reliability, and practice items should be included to insure that the subject understands the task.

2. Further study should be undertaken to determine if the superiority in performance on the test of boys over girls is a function of the particular sample used, and if not, if the difference is meaningful.

3. The relationship between the number of correct scores on the perceptual reorganization test and achievement scores in reading should be investigated.

4. The relationship between time taken to perform the figures on the test and children's reading and achievement should be investigated.

5. Since the difference between the time taken to draw the figures forward and the time taken to draw the figures reversed could be a measure of the difficulty a child has in reorienting significant parts of a figure, the reading and achievement scores of children with large difference scores in time should be investigated.

6. No attempt was made in the present study to analyze the types of errors made on the test. This may well prove important in further research.

RF 1603 Form #11
A

NAME____

SCHOOL______________________________ GRADE__________

DATE________________________________ AGE____________

EXAMINER____

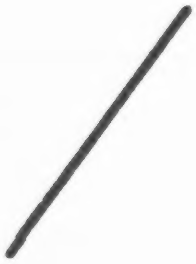		
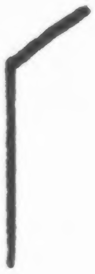		
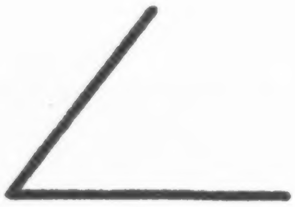		
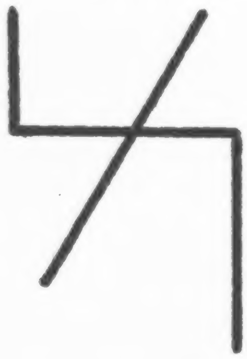		

Figure 2

RF 1603 Form #11
A

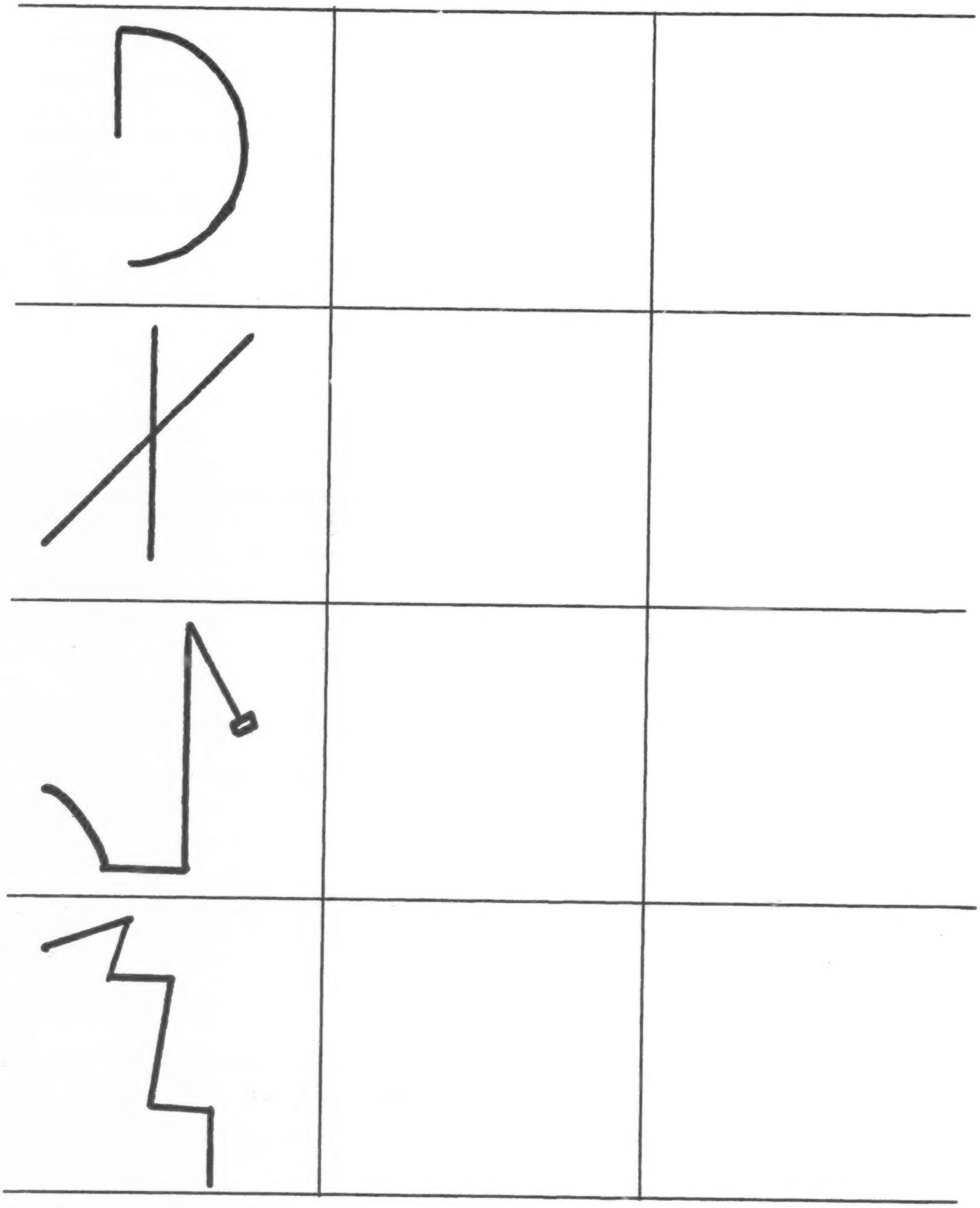

Figure 2 Continued

RF 1603 Form #11
B

NAME____

SCHOOL______________________________ GRADE__________

DATE______________________________ AGE__________

EXAMINER______________________________________

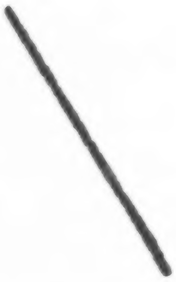		
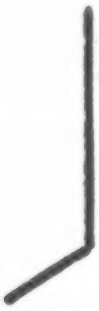		
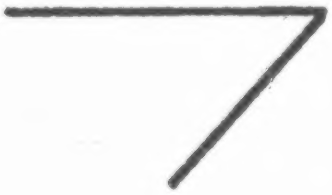		
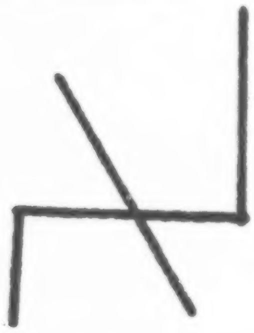		

Figure 3

RF 1603 Form #11
B

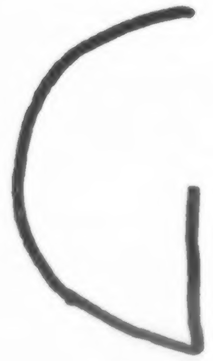		
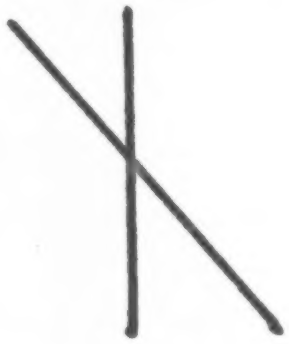		
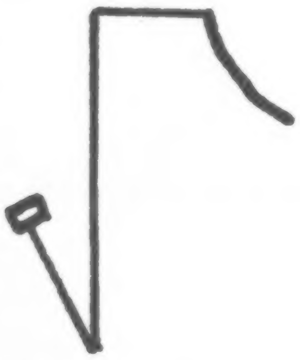		
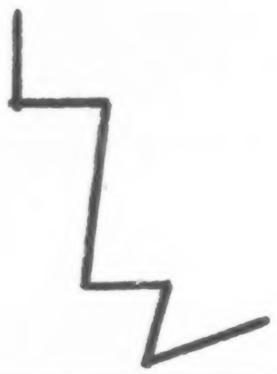		

Figure 3 Continued

APPENDIX C

Abstracts of theses conducted under and supported in part through the research contract.

The Development of Perceptual Reorganization Skills

Jean Buckley Aurand, M.A.
Department of Psychology

To measure perceptual reorganization, a test requiring the drawing of figures in reversed orientation was given to thirty boys and thirty girls in grades one through four. Scores increase between one and four, but perceptual reorganization apparently develops prior to or simultaneously with perception in grades one through four.

The Van Orden Star and Its Relationship to Reading Achievement

Carolyn Lentz Braddom, M.A.
Department of Psychology

The present study was designed to determine norms for the Van Orden Star Test of visual perception; and, to determine whether there was any significant relationships between the performance on the test of over-achieving and under-achieving children. The results failed to show both interpretable relationships to reading achievement and significant relationships to age.

A Study of the Van Orden Star and the Cheiro Scopic Drawing as Tests of Children's Vision

Marilyn Gene Dwight, M.A.
Department of Psychology

The purpose of the study was to determine whether the norms obtained from a previous study were representative of the general population of children tested for visual defects by the Van Orden Star and the Cheiroscopic drawing. The tests were found to be reliable: in addition, age was not found to be a function in performance.

The Cheiroscopic Drawing Test and Reading Disability

Margaret Virginia Grisseau, M.A.
Department of Psychology

The purpose of the study was to see whether children perform significantly better on the cheiroscopic drawing test as they increase in age and in achievement in reading. According to the data computed, performance on the test was related neither to age nor to achievement in reading.

An Analysis of Clerical Errors in the Administration and Scoring of the Wechsler Intelligence Scale for Children

Shelton O. Williams, M.A.
Department of Psychology

109 WISC protocols from 43 psychologists practicing in 10 states were examined for clerical errors of computation, conversion, recording and bonus. I.Q.'s were changed from 1 to 14 points in over 21% of the protocols examined as a result of 105 of the 582 errors identified.

3

APPENDIX D

WISC SUBTEST SYNDROME

The data collected during the study of vision training and learning to read provide a unique opportunity to answer several questions regarding the WISC subtest score of disabled readers.

The usefulness of WISC subtest patterns in diagnosis of reading disability has been implied frequently since 1950. A review of the studies suggests that the pattern is relatively well established despite differences in procedure, design, and subjects. The value of such a pattern (or of such patterns) would lie in the assistance it would give diagnosticians in identifying cases of reading disability, in subclassifying them, in providing clues to instructional methods and objectives, and in promoting preventive methods.

Although 23 studies were identified and reviewed, none was found to provide satisfactory direct evidence regarding subtest patterns applicable to individuals.

In 1952, Graham, using 96 children aged 8-0 to 16-11 of whom 31 had WISC test scores, found arithmetic digit symbol (coding) to be the lowest scores. Twelve of the 31 had verbal IQ lower than performance although full scale IQ of the 31 is average (100.3). Interpretation of the study is difficult because of the mixing of Wechsler-Bellevue I and Wechsler-Bellevue II tests in with the WISC and because of the investigator's failure to indicate statistical significance.

Beck (1955) in an umpublished study of the WISC scores of retarded readers (14 girls and 57 boys) found, in general, no differences between boys and girls. Beck's data, however, indicate that there may be differences in subtest patterns between boys and girls. Both appear to be low in arithmetic and Digit Span. Boys appear to be low in coding but not girls. Beck's data also suggest that her population may be different from Graham's since the two patterns are alike except for the higher vocabulary scores on Beck's sample. This may imply socio-economic-cultural differences.

In 1955, Burks and Bruce compared good and poor readers WISC responses using 6 girls and 5 boys in the "good" group and 5 girls and 26 boys in the "poor" group. They found poor readers low in Information, Arithmetic and Coding, but high in Picture Arrangement, Block Design and Comprehension. Good readers were high in Similarities. The imbalance of boys in the poor group and the 16 point IQ difference between the groups are complicating factors to interpretation.

Richardson and Surko (1956), using 105 children and adolescents (CA range 8-18) referred to the juvenile court, found that their subtest pattern agreed with Wechsler's pattern of adolescent psychopath. Despite an average Full Scale IQ of 88.4, they computed the significance of the difference between each subtest mean and an assumed mean of 10. Beck's 1955 study also suggested that Wechsler's psychopath pattern was similar to that of the disabled reader.

Graham and Kamano (1958), despite the design error of comparing reading achievement with chronological age rather than mental age, also demonstrated that Wechsler's WAIS pattern of adolescent psychopathology is in reality a reading disability pattern. Their comparison of 33 unsuccessful readers with 35 successful readers indicates high performance scores and low subtest scores in Information, Arithmetic and Vocabulary.

Altus, in 1956, reported a study in which 25 disabled readers in grades 3 through 8 showed a negligible difference between Verbal and Performance IQ (confirming Graham) and low Information, Arithmetic and Coding.

In 1959, Sheldon and Garton reported a replication of the Altus study using 7 boys and 4 girls (CA 7-0 to 14-8) who were disabled readers and a matched control group. Their evidence tended to confirm Altus' conclusions. However, Spache's 1957 study of 100 children and adolescents (CA 6-9 to 16) indicated that disabled readers tended to be higher in subtests of Comprehension, Picture Completion and Picture Arrangement and possibly Similarities and Object Assembly, and lower in Coding and possibly Arithmetic. They found Performance IQ to be significantly higher, 66 being higher on the performance scale than on the verbal and 31 higher on the verbal scale than on the performance. Spache's study may well be the first to indicate subclassification of reading disability based on verbal-performance differences in mental ability.

Dockrell (1960) confirmed the findings of Graham, Burks and Bruce, and Altus. He found low Information, Arithmetic and Coding and High Picture Arrangement and Picture Completion, using 29 boys showing a 2-year disability on the Gray Oral.

Robeck (1960) used subtest scaled scores divergent from the subjects' own mean and found that the 36 cases conformed to the pattern at an average of 6 out of 11 characteristics and that each of the 11 characteristics was correct from 17 to 21 times out of a possible 36. Her pattern was not tried out on non-disabled nor on over-achieving readers. She found that the disabled reader was low in Information, Arithmetic, Digit Span and Coding, but high in Comprehension, Similarities, Vocabulary, Picture Completion, Picture Arrangement, Block Design, and Object Assembly. Robeck's study appears to be the first involving validation (although it is circular validation rather than cross validation).

Hirst's study (1960) contributed two new ideas (1) by using a two-dimension chart combining deviation from national mean for the subtest on one dimension and from subjects' mean for the subtests on the other dimension, and (2) by considering that the subtest patterns of the severely disabled and mildly disabled readers might be different. Both were low in Coding, Arithmetic and Digit Span and high in Picture Completion and Picture Arrangement. The severely disabled were also high in Object Assembly.

Kallos et al (1961) added somewhat to the picture. They found no difference between Performance and Verbal IQs but diagnostic value in low Information, Arithmetic and Coding and in high Block Design, tending to agree with Altus except for the high Block Design. The 37 boys were selected to have IQs in the 90 to 109 range in order to eliminate the distortion from high and low IQs. They have, therefore, raised the qu question as to whether the subtest pattern differs for subjects within the high, low, and middle IQ ranges.

Neville (1961) studied 53 disabled male readers with IQs of 90 and above who were reading at least two years below mental age level. He also studied a control group matched for sex, grade level and Full Scale IQ who had been referred to the clinic for suspected reading problems but who did not appear to be disabled in reading. Psychological evaluation referrals were excluded. Findings reveal verbal scores lower than performance at the 1% level of confidence and that Information, Arithmetic and Digit Span were low and Picture Arrangement and Block Design were high when disabled readers were compared to non-disabled readers. Neville comments that the low scores seem to be related to school task and high scores to non-formal learning tasks and speculates that the disabled reader most likely does not become active in verbal tasks. He appears to feel that remedial techniques should emphasize kinesthetic and visual approaches and that there is little hope for remediation beyond the primary grades. McLeod (1965) is critical of this inference, claiming that such an influence is mandatory in view of the procedure in selecting the subjects and, therefore, is not justified.

Paterra's (1963) subjects consisted of 33 disabled readers of average or above IQ and ranging in CA from 6-5 to 14-6. Thirteen children had higher verbal scores and 19 had higher performance scores. In the high verbal group, Comprehension and Similarities were higher than Arithmetic, Vocabulary, Picture Completion, Block Design, Digit Span, and Coding. In the high performance group, Picture Completion was higher than Information, Arithmetic, Vocabulary, Block Design, and Object Assembly. She also divided her subjects into a younger and an older age group. In these age groups having high verbal she found that Comprehension was high for both groups, Information and Arithmetic were high for the younger group and Similarities for the older group. In the group having higher performance scores, she found that Picture Completion was high for both age groups; Information, Arithmetic, and Vocabulary were low for the younger group; and Comprehension, Similarities and Picture Completion were high for the older group. There were 10 children who had 15 points difference between the verbal and performance IQ's. An analysis of the results on the WISC with this latter group showed Arithmetic was outstandingly high for the young verbal group and Comprehension and Similarities were high for the the older verbal group, while Picture Completion was high in the high performance group at both age levels, and Information, Arithmetic and Vocabulary were low at both age levels. She concludes that the Similarities test shows the greatest variability with age of high or low verbal score, children with reading disabilities tend to be high on Picture Completion and Comprehension and consistently low on Vocabulary. Disabled readers with higher verbal IQ show greater variability than those with higher performance IQ. Paterra's extensive study points toward changes with age (appoint also considered by Beck in 1955) and toward verbal-performance IQ differences as a means of subclassification (a point also considered by Spache in 1957). She is, however, the first one to consider pattern differences along both age and IQ dimensions. It is unfortunate that n within cells is so small.

Coleman and Rosef (1963) studied the WISC subtest scores of 126 underachievers and 20 overachievers whose CA's ranged from 7-5 to 16. Underachievement was calculated against CA and grade placement instead of MA. Underachievers were low in subtests involving school-type learning, concentration and memory (Information, Arithmetic, Vocabulary, Digit Span, and Coding) and high in subtests loaded with perceptual organization and informal learning (Comprehension, Picture Completion and Block Design). The pattern was not affected by level of intelligence and degree of underachievement. Overachievers who are in academic difficulties (high Information and Vocabulary, but low Coding) showed some opposing tendencies in subtest patterns and also showed a high degree of scatter which may reflect emotional problems related to their academic difficulties.

In her second study, Robeck (1963) considered the responses of 20 reading clinic cases (selected from among 80) whose major difficulty was word attack skill. Ages ranged from 7 to 12, grades from II to VII, and IQ from 98 to 136. They showed a WISC subtest pattern significantly high in Comprehension, Similarities, Vocabulary, Picture Comprehension, Block Design, And Picture Arrangment and low in Information, Arithmetic, Digit Span and Coding. No difference was found with Picture Arrangement and Object Assembly. Verbal-Performance IQ differences were not presented. Robeck noted that all 20 showed oral reading errors at the frustration level when reading from materials comparable in difficulty to individual silent reading achievement levels.

In her third study, Robeck (1964) reported on the WISC subtest scores of 80 children (68 boys and 12 girls) aged 6-10 to 13-9. She compared the mean subtest scores of this clinic group with the mean subtest scores of the standardization sample and found the disabled readers to be high in Comprehension, Similarities, Vocabulary, Picture Completion and Block Design, and low in Information, Arithmetic, Digit Span and Coding. She concluded that disabled readers were high in verbal areas involving judgment and ability to recall specific verbal material. They could deal more effectively with figural than with symbolic materials on perfromance tests. It may be that the 80 Ss referred to in this study are the same 80 from which she selected 20 for the study reported in 1963.

McDonald (1964) considered 60 male disabled readers 16 to 19 years old. Using the WAIS he found 30% were high in Verbal IQ and 64% in Performance IQ. Mean Vocabulary and Performance score difference (9.5 IQ points) is significatn. The disabled readers were lower in Information, Arithmetic, Digit Span and Digit Symbol (Coding), but high in Comprehension, Picture Completion, Block Design and Object Assembly. McDonald used no comparable group of non-disabled readers.

Sandstedt's (1964) study has some implications for the present study. She found no verbal-performance difference for 45 children aged 8 to 13 disabled 2 to 7 years. (Her sample, therefore, may be atypical.) She concluded that visual and auditory memory span tests were useful in diagnostic testing of these 38 boys and 7 girls.

McLean (1964) studied four groups of boys: well-adjusted disabled readers, well-adjusted non-disabled readers, poorly-adjusted disabled readers. and poorly adjusted non-disabled readers. His data indicate 1) that disabled readers were significantly lower in verbal IQ than in performance IQ; 2) that among the four groups a. there were no significant differences in Comprehension, Similarities, Picture Arrangement, Block Design and Object Assembly; b. there were higher scores in Picture Completion among the disabled groups; c. the well-adjusted non-disabled readers were different from the other three, and d. the poorly adjusted readers have greater extremes, and 3) that cross-validation correctly identified 86% of the disabled readers and 80% of the poorly-adjusted. He concluded that age, mental age, socio-economic level, educational experience and emotional adjustment must be considered to draw valid conclusions regarding WISC profiles, that reading disability and emotional disability exert similar influences on WISC subtest patterns, that differences in past research may be caused by intellectual levels and adjustment ratios, and that the use of linear geometric distance may differentiate groups of disabled readers. However, McLean's study is difficult to interpret since he neglected to report the size of his four groups. McLean appears to confirm the observation of Coleman and Rasof that those with adjustment problems tend to have wide subtest scatter.

McLeod (1965) compared WISC scores of 116 children (85 boys and 31 girls) referred to the Remedial Education Centre in Queensland with 177 successful readers (100 boys and 77 girls) from England. He concluded 1) that for children of a given verbal or full scale IQ the disabled readers are lower than the control group in Information, Vocabulary, Arithmetic, Digit Span and Coding, and higher on Picture Completion; 2) that for children of a given performance IQ the disabled group was lower than the successful group in all verbal tests, coding and Picture Arrangement; 3) that the differentiating power of Digit Span and Coding may be different from that of Information, Arithmetic, and Vocabulary, and 4) that Coding and Picture Arrangement may belong more to the verbal scale than to the performance scale.

Wingert (1965), in an unpublished exploratory study, considered the WISC scores of 25 boys in each of two groups, mildly and severely disabled in reading. The IQs of the severely retarded group ranged from 95 to 127 with a mean score of 109.3. The full scale IQs of the mildly retarded group ranged about 4 points lower. The subtests discriminated between the 2 groups was significant at the 5% level. The Picture Completion and Object Assembly in favor of the severely disabled group contributed most to the discrimination between the two groups.

Sawyer's (1965) study was more extensive. She used 90 mildly disabled and 90 severely disabled readers, 30 in each 2 1/2 year age bracket beginning at 8.0, 10.5, and 13.0. A child was classified as mildly disabled if his achievement level was one or more years below capacity level and he had made at least half the progress expected of him. IQs were held within the 91-119 range. Sawyer was able to discriminate between the severely and mildly retarded individuals maintaining exceptionally high reliability on cross-validation. Discrimination involves weights applied as multipliers to the subtest raw scores. Critical scores are also given. Sawyer indicates that the evidence implies 1) that teachers need to use radically different methods with the severely disabled reader and 2) that the WISC can be used for early identification of these children. Wingert and Sawyer differ with Coleman and Rosef on this point probably as the result of differing definitions of reading disability.

Corwin (1967) studied the WISC subtest patterns of two groups of 30 good and poor 4th and 5th grade readers matched for age, grade, and Lorge-Thorndike Non-Verbal IQ as identified by teachers. Differences in Information, Digit Span and Coding were in favor of the good readers at the 1% level of confidence. Differences in Arithmetic were in favor of the good readers at the 5% level. Initial selection of subjects on the basis of a non-verbal test may have influenced the findings, possibly eliminating performance test differences between the two groups on the WISC and accenting the verbal and full-scale differences found on the WISC.

Belmont and Birch (1967) studied extensively the WISC profiles of 150 disabled readers. Initially they defined reading disability as low achievement and later eliminated the subjects with IQs below 90, in effect re-defining reading disability as underachievement. All subjects were boys of 9 and 10 years of age. Evidence was considered in terms of IQ level and also separately for 22 of the most severely disabled readers matched by IQ with normal achieving readers. Low scores were found in Information, Arithmetic, Vocabulary, Object Assembly and Coding. Performance IQ was high and Verbal IQ was low for disabled readers at the 2% level of confidence. Among their conclusions are: 1) Disabled readers function better on the performance scale and less well on the verbal scale than normal readers; 2) Inadequacy of language functioning and not perceptual or manipulative skills characterize the 9-10 year old disabled reader. (These two conclusions tend to confirm the findings of Coleman and Rosof in 1963.) 3) Responses to the Vocabulary subtest indicate that disabled readers knew fewer words and defined more words descriptively rather than categorically as did the normal achieving readers.

It is, of course, desirable that all research on the same question yield the same results. In the present review, however, the lack of consistency is not surprising. There has been a serious disagreement in defining reading disability. Several investigators, even as late as 1967, have defined it as low achievement, i.e., the lowest achieving readers in the class. In the present investigation reading disability is defined as achievement below capacity level -- underachievement. The difference between achievement and capacity to achieve should distribute along the normal curve and the mean should be zero (no difference). The estimate of one standard deviation along this curve is 1.0 years.* Some investigators have defined reading disability as a capacity-achievement difference of two years. This could have been an appropriate (though probably high) figure at the time of their investigations.

There are other differences that may confound the investigators. 1) Some studies are limited to boys. There may be boy-girl differences in patterning on the WISC; 2) Some investigators selected from their own clinic populations. These populations vary from clinic to clinic probably depending upon both client socio-economic level and fees. Certainly both cultural differences and the degree of cultural influence upon the subject could influence the findings; 3) Age differences appear also to be important. Probably studies in this area that have a wide age range among the subjects should be discounted; 4) Some investigators compared their subjects' mean scores with those of the standardization sample without adjusting for general IQ differences. Others have compared the mean scores of two groups selected simultaneously. Still others have compared the WISC scaled scores of each subject with his own mean scaled score (Full Scale or Verbal and Performance separately); 5) The number of subjects varied considerably from study to study. Sheldon and Garton used 11; Belmont and Birch used 150; Paterra used 33 but on occasion drew conclusions from groups as small as 10. 6) In all but one study the degree of emotional adjustment was not considered. McLean suggests that adjustment may well be a confounding factor in interpreting the pattern of WISC scores for disabled readers; 7) In very few studies was either cross-validation or circular validation attempted.

Conclusions from previous studies: The conclusions reached and the evidence presented in the 23 studies point toward several conclusions:

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*The investigator's own research (unpublished) in the middle 50's indicated that one Standard Deviation of this score was 1.7-1.8 years. Two studies to define it more carefully are under way.

1. Twenty of the studies lend themselves to pattern analysis. They indicate that the disabled-reader-pattern would include low scores in Information, Arithmetic and Coding. Low scores appeared in 16, 20 and 19 of the 20 studies. Low scores in Digit Span and high scores in Picture Completion appeared in 12 and 10 of the 20 studies.

2. The high performance IQ score in relation to verbal appears in about 60 percent of the disabled readers. It is possible that the relationship between verbal and performance IQs might reveal sub-classifications of disabled readers: high performance IQ, high verbal IQ, or equal performance and verbal IQ. Subtest patterns should be studied for these three much as Paterra did (but with a larger number of subjects). Probably Coding should be considered as a verbal test for this purpose. This would involve a modification in standardization and extensive though not impossible statistical treatment.

3. Sawyer's technique of weighting WISC raw scores should be tried out with reading disabled and non-disabled children. Such a procedure may a. provide for early identification and/or b. suggest instructional procedures.

4. Several investigators have stated or implied that schools should use radically different instructional procedures with certain of the disabled readers. Often the suggestion was made in regard to disabled readers who showed high performance IQs and low scores in subtests related to school learning. It may be that the WISC subtest of each disabled reader should be considered individually as indicating hypotheses regarding the individual's instruction. Since the subtests are short, each should not be expected to yield scores reliable enough to be applied to individuals. In diagnosis they may, however, reveal hypotheses about individuals that could be verified or rejected through other evidence and observation.

The review of the studies has raised several questions that can (and some that can't) be answered with evidence gathered for the study of vision training and learning to read.

Design

From 27 school districts in 10 states generally north of North Carolina and east of Illinois, 378 4th grade children were selected as underachievers in reading using local school administered standarized tests. All but 26 were given WISC and Gates Reading Survey tests during the fall of 1963 or 1964 by school psychologists approved by the local districts.

The 26 could not be used because of the unwillingness of some school personnel to release complete data and because of minor variations among psychologists in test administration (such as administering 8 WISC subtests instead of 10, or of omission of one subtest), or because of fail-

TABLE B1

LOW AND HIGH SUBTESTS CHARACTERISTIC OF DISABLED READERS FOUND IN TWENTY STUDIES

		Information	Comprehension	Arithmetic	Similarities	Vocabulary	Digit Span	Picture Arr.	Picture Comp.	Block Design	Object Assembly	Coding
Graham	1952			L		L			H			L
Beck	1955			L			L					L
Burks +	1955	L		L				H		H		L
Altus	1956	L		L		H						L
Richardson +	1956	L	L	L	L	L	L			L		L
Spache	1957		H	L				H	H			L
Graham +	1958	L	L	L	L	L	L					L
Sheldon +	1959	L	L	L		L				H	H	L
Dockrell	1960	L		L		L		H	H			L
Hirst	1960			L			L	H	H		H	L
Robeck	1960	L	H	L	H	H	L	H	H	H	H	L
Kallos +	1961	L		L						H		L
Neville	1961	L		L			L	H		H		
Robeck	1963	L	H	L	H	H	L	H	H	H		L
Coleman +	1963	L	H	L		L	L		H	H		L
McDonald	1964	L	H	L			L	H	H	H	H	L
Robeck	1964	L	H	L	H	H	L		H	H		L
McLeod	1965	L		L		L	L		H			L
Corwin	1967	L		L			L					L
Belmont +	1967	L		L		L					L	L
Number Low		16	3	20	2	8	12	0	0	1	1	19
Number High		0	6	0	3	4	0	8	10	9	4	0

ure of the psychologist to administer the reading tests.

For each child of the 352, MA was calculated (CA as of date of reading test X IQ) and it was subtracted from reading age. Two groups of children were selected. Those whose RA-MA score was -1-5 year or a larger negative number (N = 101) and those whose RA-MA score was +.2 or higher (N = 56). The 101 are called underachievers and the 56 are called achievers. The scores of the remaining 195 children are occasionally considered.

Question 1: Is the WISC pattern of low scores in Information, Arithmetic and Coding applicable to individuals?

The scaled scores of the 101 underachievers and of the 56 achievers were examined to determine the number of children who would be identified by means of the pattern. All weighted scores falling 3 points or more above and below the S's own mean weighted subtest score were noted. Each S's score on Information, Arithmetic and Coding was examined. The evidence, compiled in Table B2, shows that not one of the 101 underachievers was low on all three subtests. Furthermore, only six of the 101 were low on two of the tests and 63% of the underachievers failed to be significantly low on even one of the three tests. The evidence appears to indicate that very few, if any, underachieving children conform significantly and individually to the low Information, Arithmetic, Coding pattern.

TABLE B2

NUMBERS OF UNDERACHIEVERS AND OF ACHIEVERS IDENTIFIED THROUGH THE WISC PATTERN

	Low On			
	3 Tests	2 Tests	1 Test	No Tests
Underachievers	0	6	31	64 (63%)
Achievers	0	0	6	50 (80%)

	Low On			N
	Information	Arithmetic	Coding	
Underachievers	13	11	19	101
Achievers	0	2 (4%)	4 (7%)	56

The Information, Arithmetic, Coding scores of the 56 achieving children were also examined. No child's scores were low on all three

TABLE B3

Number of Ss Varying from Mean
WISC Subtest Scores in Two Studies

	N = 100 Spache			N = 101 Huelsman Underachievers		N = 56 Achievers	
	+	-		+	-	+	-
Information	6	2		1	13	5	0
Comprehension	17	1	**	9	8	1	11
Arithmetic	2	10	*	3	10	6	2
Similarities	11	2	*	8	7	9	1
Verbal	6	2		4	7	2	1
Picture Comp.	14	2	**	16	5	4	12
Picture Arr.	15	4	**	13	6	6	4
Block Design	7	9		11	7	5	8
Object Assembly	9	2	*	20	6	4	7
Coding	4	20	**	4	19	11	4
TOTAL	91 (9%)	54 (5%)		89 (9%)	88 (9%)	53 (10%)	50 (8%)

** Significant at 1% level of confidence

* Significant at 5% level of confidence

nor on any two of the three subtests, and 80% failed to show low scores on any of the three subtests.

The comparison of the number (and percentages) of underachievers with achievers who have low Information,Arithmetic, Coding subtest scores leads toward the conclusion that the pattern is characteristic of the group and that the children of the present study probably do not differ from those of other studies; however, the conclusion that individual underachievers in reading conform to the Information, Arithmetic, Coding pattern cannot be drawn.

There is an implication here that some disabled readers conform to the Information, Arithmetic, Coding pattern; however, which ones cannot be determined at the moment. It would be advantageous at this point, for for research to turn away from searching for a pattern and to turn toward analysis of the possible significance of low subtest scores in the instructional program of individual children. Such research would be much more meaningful to those who interpret tests and who work with children.

Question 2: Does the group of 101 underachievers show a WISC subtest pattern similar to that shown by Spache and other investigators?

Spache (1957); Robeck (1960), and Hirst (1960) adhered closely to the Wechsler technique and compared the subtest weighted scores of each subject with his own subtest mean weighted score. Spache used a weighted score difference of 3. Robeck used the SE_m for each subtest. Hirst used a two-way analysis combining both difference from subjects' own mean and difference from the standarization group mean of 10.

In the present study, the method used by Spache was followed. The mean subtest weighted score was calculated for each subject. The mean was then subtracted from each subtest score. Then the numbers of subjects whose difference score equaled or exceeded -3.0 and +3.0 were determined. These data for achievers and underachievers are presented in Table B3. Spache's data are presented for comparison.

It is interesting to note that Spache's data are generally confirmed for all performance tests and for the arithmetic verbal test. The 101 children in the present study appear to be low in Information, not confirmed in the Spache study. The responses of achievers in the present study show opposing tendencies in Arithmetic, Picture Completion, Block Design and Coding. It is also interesting to note that, in five of the six columns, the total number of significantly deviating subtest scores is about 9% of the total number of scores. Thus, the achievers show the same rate of deviate scores as the underachievers. Spache's sample appears to have fewer low scores in Information, Comprehension and Verbal than the present study, a fact which may account for the 5% N rather than 9% in the negative column of that study.

We used several methods to determine the level of confidence for these data. Spache did not describe the method he employed. None of our methods yielded the results he obtained. Furthermore, none of our techniques was theoretically appropriate. However, they tended to show believable differences in Information, Object Assembly, and Coding for the 101 underachievers and in Comprehension, Similarities and Picture Completion for the achievers.

Robeck's method was also attempted, except that SD was used instead of SE_m. Not unexpectedly, significant deviations in subtest mean scores were found in only four rather than in all eleven of the subtests. These were low Information, Arithmetic, and Coding and high Object Assembly.

Conclusion

Although the low Information, Arithmetic, Coding pattern appears to characterize groups of disabled readers, interpretation of low and high WISC subtest scores probably should not be restricted to the Information, Arithmetic, Coding subtests and in fact probably should not be restricted to underachievers, inasmuch as achievers have about the same incidence of high and low subtest scores.

Interpretation

Sample differences probably account for some of the differences in conclusions among the studies reviewed. One obvious difference between the 100 sample of Spache and the 101 of our sample lies in the Information subtest where Spache found no difference. A second difference is apparent in our 101 sample which shows high Object Assembly scores, reported in only four of the 20 previous investigations. We believed, therefore, that our sample was about as typical as the others and that groups of disabled readers (at least those aged 9 to 10 years old) would show a low Information, Arithmetic, Coding pattern.

It is also important to note that the data tends to show that many disabled readers do not show the low Information, Arithmetic, Coding pattern as individuals. For example, only 20 of Spache's 100 and 19 of our 101 were significantly low in coding and only 10 in each study were low in arithmetic.

Question 3: Is a high performance scale IQ characteristic of disabled readers?

Twelve of the 23 studies have reported that performance IQ is higher than verbal among disabled readers. Three studies reported the number of children involved. Graham (1952) indicated that 19 of 31 (61%) had higher performance scores; Spache reports 66 of 100 and Paterra 19 of 33 (58%). In the present study, 62 of 101 (61%) had Performance IQs 1 or more points higher than Verbal. Among the 56 achievers, 21 (38%) had Performance IQ scores 1 or more points higher than Verbal. If a 15 point difference is used as an indicator of a statistically reliable difference, only 1 of the 56 had a high Performance score and 5 had high Verbal scores. If a similar difference is required from the 101 disabled readers, 22 had high Performance IQ scores and 1 had a high Verbal IQ score.

Ten of the earlier studies showed mean Performance and Verbal IQ scores. All differences show Performance mean IQ to be higher -- only two gave the level of confidence. Altus (1956) stated that the difference of 2.6 IQ points was not significant. Spache (1957) stated that the 6.1 difference was significant. In the present study, a difference of 4.7 IQ points was significant at the 1% level of confidence.

These data reveal that high performance IQs tend to be present among about 60% of the disabled readers and that at the grade 4 level, a believable difference can be expected in about 1/5 of the children.

Question 4: Is a low Information, Arithmetic, Coding pattern expected if high performance IQs are present?

Paterra considered this question but her N was much too small to draw reliable conclusions. The 101 disabled readers were divided into three groups: I. those with PIQ 15 or more points above VIQ; II. those with neither high P nor high VIQ, and III. those with VIQ 5 or more points above PIQ. (If a 15 point difference had been selected, only one child would have been screened. However, there are some results worth considering.)

The various Ns and percentages are listed in Table B4. Of the high Performance group, 32% have low Information and 23% have low Arithmetic; of the high Verbal group, 41% have low coding. Part of the difference could be accounted for by the fact that low Information and Arithmetic would tend to increase the Performance-Verbal difference for the high Performance group and by the fact that low Coding would tend to increase the Performance-Verbal difference for the high V group. However, if coding were really a verbal test as is claimed by some investigators, it would not seem likely that 41% of the high Verbal group would have low Coding scores. These findings tend to confirm some of Paterra's. She found Information, Arithmetic and Verbal to be low among the 15 point high Performance group, and Coding, among other tests, to be low among the high Verbal group.

Interpretation: The next evidence reinforces the belief that score differences on the WISC should be considered as indicating hypotheses to be checked by further study and observation of a particular child. Research into the significance of High Performance, High Verbal, and associated low Information and Arithmetic or low Coding is needed.

TABLE B4

Numbers of Ss with Low Information, Arithmetic and Coding Scores Classified by Performance-Verbal Difference and the WISC

	Number				Percent		
	N	I	A	Co	I	A	Co
High P	22	7	5	1	32	23	5
P - V	57	4	5	8	7	9	14
High V	22	2	1	9	9	5	41
Total	101	13	11	18	13	12	18

Question 5: Can Sawyer's method be applied?

Sawyer obtained a series of weights, applied them to the raw scores of mildly and severely disabled readers and found that a score of 65.4 differentiated between the two groups at the .0005 level of confidence.

We applied the weights (total group, seven variables) to the 101 underachievers and the 56 achievers. Twenty-eight of the underachievers scored above the criterion score and 31 of the achievers scored below it, both counter-indicated by Sawyer's findings. The Chi-Square of our 2X2 table is 4.61217 and is significant at the 5% level but not at the 2% level of confidence.

Conclusion: The application of Sawyer's method to underachieving and achieving readers does not differentiate between the groups at a level of confidence where conclusions regarding individual children may be drawn.

Interpretation: Sawyer's method may be useful in differentiating severely and mildly disabled readers and it may be extended to groups of achieving and underachieving children. It is markedly limited, however, if used (a) to screen potential disabled readers or (b) to define the needs of an individual disabled reader.

Discussion:

While groups of disabled readers tend to show high PIQ and low scores in Information, Arithmetic and Coding, individual disabled generally show no items of the pattern and seldom, if ever, show the complete pattern. Since subtest scores are based on short tests and thereby are less reliable, large differences must be present before the user may feel confident that a real difference exists. We suggest a 5 point difference when comparing weight scores of subtests, a 3 point difference when comparing one subtest weighed score with the child's mean weighted score, and a 15 point difference when comparing verbal IQ with performance IQ.

Furthermore, we suggest at this point that research should be directed more toward defining the possible significance of differences in WISC scores rather than toward pattern identification which seems relatively useless.

Appendix E

A MANUAL OF PROCEDURE

for optometrists participating in research on "The Influence of Vision Training Upon the Subsequent Reading Achievement of Fourth Grade Children."

Part I - Analytical

This manual is designed by the committee to provide standard diagnostic procedures for those optometrists engaged in the research project. In this way evidence will be gathered in an orderly manner with the same information in the same sequence being obtained from each child through the use of the same procedures. The procedures which follow represent the minimum diagnostic material to be gathered. The participating optometrist is at liberty to include as many additional tests as he may deem necessary.

Instructions to Participating Optometrists:

While tests are mandatory, in some instances, useful results may not be obtained. Therefore, a possible response to be written down should be "inconclusive" or "test could not be made."

1. a. Visual Acuity. Uncorrected visual acuity should be taken testing first the right eye, then the left eye and finally, binocularly. Reporting should be done in Snellen fractions. The acuity findings should be recorded exactly, i.e., $20/20^{-2}$, $20/30^{-1}$, etc.
   b. If glasses are worn for distance, the visual acuity testing should be repeated as outlined above with the child wearing the customary correcting lenses.
2. State of Health of Eyes and Adnexa: Conduct and record your complete external and ophthalmoscopic examination.

   Both eyes must be free from pathology and free from the manifestation of any general physical disorder. Eyes must be capable of full excursions (no paralysis). NOTE: (If child does not meet these criteria, the examination is stopped and the child is removed from the study.)

3. Ophthalmometer:
(2)

Record actual values and axes of primary and secondary meridians.

4. Habitual Phoria at Far
(3)

Taken through the distance Rx if the patient normally wears glasses for distance. If not, taken through plano.

Target is a vertical row of 20/20 Snellen letters. If the child does not have 20/20 acuity, use the smallest letters he can see. Dissociate with six diopters of vertical prism. Make the child aware of two rows of letters. Introduce sufficient base in prism until the two images are widely separated. Tell the child the images will begin to approach each other and to say "stop" at the precise moment the top row of letters is directly above the bottom row. Instruct the child to read the letters to you in the stationary chart during the test. Next, reduce the base in prism slowly until the patient says "stop." The amount of prism giving vertical alignment is recorded as the amount of esophoria, exophoria or orthophoria.

5. Habitual Phoria at Near
(13A)

This is done exactly as phoria at far and recorded in the same manner. A block of 20/30 letters is used at 16 inches and the target is brightly illuminated (18 - 20 F.C.). The prism power giving vertical alignment is recorded as exophoria, esophoria or orthophoria.

6. Static Retinoscopy
(4)

Record net static retinoscopy

7. Dynamic Retinoscopy
(5)

The child is asked to observe the small letters around the hole in the card provided. The gross lens power determined by the static is placed in the phoropter. The examiner works at 20 inches, calling the child's attention to the various letters as he scopes. Sufficient plus is added to cause a definite against motion in all meridians. If necessary, modify cylindrical component of Rx. With the child's attention called to the letters on the card as a control, plus lens power is gradually reduced until a neutral reflex is obtained. The total amount of lens power in the phoropter is recorded without making any deductions.

8. Subjective

(7) Make your customary subjective test and record the maximum plus which affords full 20/20 acuity (if possible. If not, the best possible acuity.) as the subjective finding. Record also the maximum acuity through further reduction of plus (20/15, 20/10 etc.) for O.D., O.S., and O.U.

9. Induced Phoria

(8) This test is done exactly as test 4 except that at this time the finding is taken through the subjective.

10. Adduction or Positive Relative Convergence at Far

(9) Have the child look at the vertical row of 20/20 letters on the distance chart through the subjective lenses. Ask him to tell you exactly when the letters blur. Demonstrate a blur by adding +.25 to +.50 binocularly to the subjective. Remove the additional plus and slowly introduce base out prism in equal amounts before each eye simultaneously until a blur is reported. The total amount of base out prism which causes the first recognizable blur is recorded as the adduction finding.

11. Base Out to Break and Recovery

(10) Use a vertical row of 20/20 letters

Introduce prism base out until the child reports that the target doubles. At times the child may see the targets double and then fuse the targets again. Be sure sufficient base out prism is introduced to induce diplopia and have it remain. The amount of base out prism necessary to make the child see double and maintain the two images is recorded as the base out to break finding. At this point the child is asked to report when the two targets have moved back together and become single again. Slowly and simultaneously reduce the amount of base out prism. Note the amount of base out prism in place as soon as the child reports seeing singly. This amount of base out prism is reported as the recovery finding.

12. Abduction or Negative Fusional Reserve at Far
(11) The test is done and recorded in the same manner as #10, except base in prism is used to determine the break finding and reduced to determine the recovery.

13. Vertical Phorias at Distance
(12) A horizontal row of 20/20 letters is viewed through the subjective finding. Enough base in prism is introduced before one eye to cause diplopia. The child is asked to read the stationary target and report whether the two images are level or not. If they are not level, align by introducing vertical prism before the other eye. The amount of vertical prism necessary for alignment is recorded as the vertical phoria.

14. Supra and Infraduction at Distance
(12) Using the same row of 20/20 letters and the subjective lens formula, gradually introduce base down prism before the right eye and ask the child to report when he sees two rows. Then reduce the base down prism until he sees one target. Record the two prism findings as the break and recovery for the right supra-duction. Prism base up is now used in the same manner before the right eye for the break and reduced for the recovery and recorded as the right infra-duction. If it becomes necessary to reduce prism past the zero point to effect a recovery, it is recorded as a minus amount. The procedure is repeated for the left eye.

This concludes the mandatory far point tests.

NEAR POINT TESTS

15. Induced Phoria at Near
(13B) This test is performed in the same manner as test #5 except that it is done with the subjective in place.

16. Unfused Cross Cylinder (target furnished by research project)

(14A) Place the cross grid chart in place at 16 inches and reduce the illumination to about 2 foot candles. Introduce enough base up prism before the left eye so that the child sees two separate charts. Place the cross cylinders in position with the minus axis at 90 degrees. Add plus binocularly until the vertical lines are blacker in both targets. Reduce plus before each eye separately until it is reported that the vertical and horizontal lines are equally black. If the child cannot obtain equality of blackness, record the amount of plus at which the vertical lines are blacker and a further reduction of .25 will make the horizontal blacker. If there is a range, record the plus end of the range.

17. Phoria Through Unfused Cross Cylinder Finding

(15A) Remove cross cylinders with the cross grid chart as the target increase base in prism until the targets are separated. Instruct the child to keep lines on stationary chart clear. Reduce the base in prism until the child reports that the cross grids are vertically aligned. Record the exophoria, orthophoria or esophoria.

18. Fused Cross Cylinder

(14B) Remove the prisms but leave the cross grid and put the cross cylinders in place. Ask the child which lines are darker The anticipated response will be that the vertical lines are darker. If so, reduce the plus until the lines are of equal blackness. Record this finding. If the child is unable to report equal intensity, record the maximum amount of plus which just makes the horizontal lines the blacker.

19. Phoria thru Fused Cross Cylinder Finding

(15B) Restore illumination to 18-20 foot candles and remove cross cylinders. Measure phoria on 20/30 block of letters at 16 inches with power of previous test in place. Record esophoria, orthophoria, or exophoria through fused cross cylinder findings.

20. Positive Relative Convergence at Near

(16A) The fixation target is a block of 20/30 letters at

16 inches. Illumination is as for test #5, 18 to 20 foot candles. The finding is taken through the subjective lens formula. Slowly add prism base out binocularly. Ask the child to read the block of letters and to report the moment the letters are so blurred they cannot be read. The moment he reports the complete blur the prism value is recorded as Positive Relative Convergence at Near. In some instances the child may report diplopia before a blur. If this occurs, repeat the test one time and if no blur is reported, record the finding as "X."

21. Positive Fusional Reserve and Recovery

(16B) This is a continuation of test #20. After the child reports a blur, continue to introduce base out prism and ask him to report when he sees double. As soon as he reports diplopia reduce the base out prism and tell him to report when the two targets recombine and become single. The total amount of base out prism necessary to cause the break is recorded as Positive Fusional Reserve and that amount which remains after recombination is recorded as Recovery.

22. Negative Relative Convergence at Near

(17A) This test is identical to test #20 except that base in prism is used to elicit the blur. Once again, some children may not be able to observe the blur before diplopia. If so, repeat once, and if there is no response to the blur, record as "X."

23. Negative Fusional Reserve

(17B) Performed as test #21, except that prism base in is added and reduced to obtain the break and recovery findings.

24. Vertical Phoria and Ductions at Near

(18) This is done in exactly the same manner as tests #13 and #14, except that it is done at 16 inches with the target a block of 20/30 letters.

25. Positive Relative Accommodation

(20) Target is a block of 20/30 letters at 16 inches. Illumination is 18 to 20 foot candles. Through the subjective lens power reduce plus or add minus binocularly until the child

reports that the target is completely blurred out. Record the total amount of minus added over the subjective as this finding.

26. Negative Relative Accommodation

(21) This test is performed in the same manner as test #25. Plus instead of minus is added to obtain the complete blur. Record the total amount of plus added over the subjective.

27. Analytical Amplitude

(19) For this test, a block of 20/30 letters is used at 13 inches. Illumination bright, #7 in place. The child is asked to start reading and report the first time he sees a definite blur in the print which remains blurred. As he reads, start reducing plus by .25 diopter steps binocularly. Reduce slowly, as oftentimes a child will report a blur momentarily and then see it clear again. The moment he can recognize that the print is definitely blurring, note the amount of power in the phoropter and calculate the amount of minus that has been introduced. (Example: #7 is plus 1.00. Child reports blur at minus 2.00. Therefore, minus 3.00 produced the blur.) This amount of minus must be combined with 2.50 which produces the #19 finding. #19 in the example would be 5.50.

The #19 is first done binocularly and then monocularly on the right and left eye to compare the two, and also to compare with the binocular finding.

28. Near Point of Accommodative Test

(22) With the subjective in place simply move the 20/30 block of letters closer to the child's eyes monocularly until he reports a blur. Record this finding as the number of centimeters to blur.

This concludes the refractive tests.

Part II

VISUAL ABILITIES - VISUAL SKILLS TESTING

At best it is difficult for the individual optometrist to quantify visual abilities or skills. It becomes even more difficult to expect a number of optometrists to score, record and think alike. Because it is felt that the majority of participants use the Keystone Telebinocular and the cards which are designed for use with it, that instrument will be the one under discussion in this manual. This is not intended to be an endorsement of the Telebinocular but only an indication of its wide use. Participating optometrists are asked to follow their usual testing procedure and to record the responses on the Keystone Doctor's Cumulative Record Form which they use in their own practice. Certain information will be requested for which there is no designation on this form. It is requested that the information be recorded on a blank sheet of paper and stapled to the form. Tests #1 through #9 must be done in a stereoscope with a 95 mm. separation and a + 5.00 lens. Tests #10, 11, and 12 must be done in a stereoscope with an 85 mm. separation and a +5.00 lens. The child should be seated at the instrument so that he looks straight ahead. There may be slight variations from the instructions (1-9) below.

Test #1. First Degree Fusion Card #1 - D B - 10A
Adjust the instrument for 0-0 on the shaft. Ask the child to close both eyes, then insert the first card in place. Tell the child to open both eyes and tell you what he sees on the card. The anticipated answer is that the child sees a dog and a pig. Next ask the child if all of the dog and all of the pig are present at the same time, or does any part of the dog or pig disappear. If the reply is in the affirmative, proceed to the next test. If the answer is in the negative, determine what part of the dog or pig disappears and indicate on the scoring sheet.

Test #2. Vertical Phoria at Far Card #2 D B - 8C
Ask the child, "Which figure does the line go through?" The response should be that it goes through the circle or ball. Record the child's response and then ask if he sees all of the line

and all of the figures at the same time, or if any part disappears. Record results on scoring sheet.

Test #3. Lateral Phoria at Far D B - 9

Immediately upon exposing the card ask the child what he sees. Further instruct him to tell you to which number the arrow points and where it moves to as soon as he sees the card. Ask him if all of the arrow and all of the numbers are present at the same time or does any part of the arrow or numbers disappear. Record the response on the scoring sheet.

Test #4. Second Degree Fusion D B - 4K

Ask the child how many balls he sees. The expected response is three. Record the child's immediate response and any corrections he might make to his original response. If there are four balls, ask which side the red one is on, the separation between the white ones and if any balls fade, move, or disappear.

Test #5. Visual Discrimination at Far D B - 3B, 2B, and 1B

The test is carefully explained to the child. Rather than use the term "right" and "left," it is explained to the child that the signboard contains five diamonds In one of the diamonds - "top," "bottom," "this side" (touching the child's right side) or "this side" (touching the child's left side) there is a black dot. Ask the child where the black dot is in the first signboard, indicating the signboard with a pointer, if necessary. Continue indicating the correct response by a check, a wrong response by an "X." Record whether the child's response is "left" or "right" or whether the child indicates the dots on the right or left side by holding up the appropriate hand or indicating the proper side of his body. Some children may indicate the correct side by confuse left and right. Indicate this type of response on the scoring sheet. After the child has gone to the last signboard correctly identified under binocular fixation, occlude the eye not being tested and determine whether he can pick out any signboards previously missed under binocular fixation. If additional signboards are seen correctly after having been missed binocularly, indicate by the letters "occ" over the signboards called correctly under occlussion.

Test #6. Depth Perception at Distance D B - 6D

Indicate to the child with a pointer that on the top row of figures there is a star, a square, a cross, a heart and a ball. Remove the pointer and tell the child that in each of the rows one symbol will appear to stand off the card and look closer to him than all the rest in that row. Tell him the cross in the middle of the top row stands out. If he sees the cross standing out, ask him to tell which one in each row looks closer to him. Record the responses on the scoring sheet.

The Instrument is Now Set at 16" -2.5 D.

Test #7. Lateral Phoria at Near D B - 9

This test is given exactly as Test #3, Lateral Phoria at Far, and is recorded in the same manner.

Test #8. Fusion at the Near Point D B - 5K

This test is given exactly as Test #3, Second Degree Fusion, and is recorded in the same manner.

Test #9. Visual Discrimination at Near D B - 16, D B - 17 and D B - 15

It is explained to the child that the cards consist of lines, dots or solid gray. The child is asked to begin with cirlce #1 and continue as far as he can go, indicating whether the circle consists of lines, dots or solid gray. Occlusion is repeated as in Test #5 and any increase in discrimination is recorded in the same manner.

At this point the child should be given a rest period of several minutes duration, preferably looking out of a window or at some distant objects.

Test #10. Selective Cancellation with Pointers A N - 1 or PG 25.

This test is done in the telebinocular or a stereoscope with 95 mm. separation and +5.00 lenses. (Not in a hand stereoscope or cheiroscope) The card is placed in the instrument with the shaft set at 0 - 0. The child is given a pointer for each hand and asked to touch the tip of the star with both pointers at the same time, beginning with number one. The sticks start from the barrel and then are brought to the card. He is then asked to proceed, in sequence, to number twelve. He is cautioned to lift the pointers from the card and return to the barrel after each number is touched. He is not to slide them as he proceeds from number to number. Indicate on the blank scoring sheet whether this test is performed easily and with skill; whether one or both pointers are placed inside or outside of the tip of the star; whether movement is "loose" or slow and deliberate; if the tip of one or both pointers fade; whether the child verbalizes while performing the test; and whether - through observation - the child appears tense or relaxed.

Test #11. Cheiroscopic Tracing

The child is instructed to "trace over" the tracing provided for the project. (The child is seated so that he looks straight ahead.)

Test #12. Van Orden Star

The child is given a freshly sharpened pencil of the same color and length for each hand. If right handed, he is asked to begin from the bottom dot on the right and the top dot on the left. If he is left handed, reverse the position of the pencils. Ask him to place the pencils on the dots and position his hands and wrists so that only the pencils touch the card. He is asked to look straight ahead and draw a line toward the center of the paper until the pencils appear to touch. He is then instructed to go up one dot on the right and one down on the left and continue drawing until all the dots are connected. Attach the completed Van Orden Star to the scoring sheet.

Test #13. Accommodative Facility

Note: There are probably as many ways of evaluation Accommodative Rock as there are optometrists evaluating this function. The suggested method is not necessarily the "best." It is suggested because it can be done simply and accurately, and its uniformity will provide more statistically valid information.)

Used reduced Snellen chart and best acuity line. The instrument is set for 16 inches. Place a --2.50 sphere before the right eye for five seconds. Ask the child if the print is readable as you change occlusion from the left to the right eye. There should be no loss of measurable acuity. If the response is that both sides are equally clear, change the --2.50 to the left eye and repeat. If the response is that the sides are not equally clear, reduce minus in one half diopter steps and alternate occlusion until patient reports both equal clarity. Repeat with +2.50.

Part III

The child should be seated in the examining chair with his feet resting on the step whenever possible. These tests are included because of their relationship to vision and its development. The reasons for their inclusion are beyond the scope of this manual of operational instructions.

PURSUIT FIXATION

Pursuit fixation is to be tested with a small silver cat bell of approximately one-half inch in diameter suspended by a thin black thread at least six inches long. The test should be done binocularly at first and then repeated with each eye occluded. The test target should be held at a distance of approximately twelve inches to fifteen inches from the nose of the patient. The bell should be moved smoothly and at a moderate speed in the following directions:

1. Horizontal
2. Vertical
3. Oblique from upper right to lower left and back
4. Oblique from upper left to lower right and back
5. Circularly clockwise
6. Circularly counterclockwise

The excursion should not be so great as to require that head turning be done in order to keep the target in view. The test should be continued long enough to determine if the subject has the ability to sustain good performance at the task as well as the ability to respond favorably at the outset.

The instructions to the patient should be as follows: "Watch the bell." No mention should be made of holding head still at this time.

Good pursuit fixation is characterized by smooth, accurate following of the target with the eyes with a minimum of overflow into head or boyd movement. If the subject cannot sustain accurate eye movements at the above mentioned optimum level, then the following should be noted:

1. Is the patient able to follow the moving target at all?
2. In what meridians is the pursuit inadequate?

3. How long can the following be sustained?
4. Does the following become more accurate or less accurate with time?
5. When the patient is not following the target accurately is the "missing" characterized by a gross misalignment of the eye or is it a "near miss"?
6. Does the type of missing remain constant or does it vary with time?
7. Does the youngster tend to overshoot or undershoot?
8. Is there headturning in place of eye movement?
9. If the head turns is the eye movement accurate with this head turning or is the eye movement still inaccurate?
10. If there is head turning do the eyes seem to be leading the head or does the head seem to be leading the eyes?
11. If there is head turning is the head movement supporting to the eye movement?
12. Does the head actually move in the proper direction or does the head move in the wrong direction?
13. Is there an overflow into body movement as well as head movement?
14. Does any part of the torso enter the act?
15. If there is head movement does the youngster seem to be aware of the fact that his head is moving?
16. Does the head movement persist in all meridians of gaze?
17. Does the head movement increase or decrease with time?
18. Does the child make verbal comments during testing?
19. Is the child aware of when he is actually aiming properly?
20. In general the pursuit fixations may be described as: failure, poor, good, excellent.

If the patient moves his head then a mild instruction should be given such as: "Now let me see you do it with your eyes alone." There should be no physical restriction of the head at the outset nor should there by any firm command not to move head. After giving the mild instruction the patient should be again observed as the target is moved in the various meridians to see if the mild suggestion that the eyes were not doing it correctly is sufficient to trigger a more appropriate response. If mild suggestion does not stop head movement then a still more direct command should be given such as: "Now try to do this with your head held still and with your eyes alone doing the moving." Again similar observation should be made as above. If there is still a persistence of head movement, then some physical restraint should be undertaken such as placing a finger on the child's forehead or cupping your hand under the child's chin. This should be done only as a last resort to see what happens. When this is done the examiner could actually feel to see whether there is any "inhibited" head turning. We are looking to see if the youngster actually can hold his head still and allow his eyes to make the move or if the youngster has to initially move his head in order to get eyes started.

Any changes in response that are brought about by changes in instructions should be recorded.

With the bell held at 6 - 8 inches from the child and directly in front of his nose, ask the child to touch the bell.

1. Does the child touch, hit, pinch or scoop from behind?
2. Does the child use full hand, two finger pincer grasp or a single finger to touch?

After making the above observations, the procedure should be repeated using a cat bell attached to a stick so that the youngster is permitted kinesthetic support by touching the target. This is to be done by actually placing the youngster's finger in contact with the bell. The examiner moves the bell as before and allows the youngster to monitor the passive movements of his own arm as he watches. Again observations should be made to see if kinesthetic support makes the eye movements more accurate or less smooth, better sustained or more poorly sustained. It is also necessary to see whether kinesthetic support tends to reduce the body activity or kinesthetic support engenders still greater body activity.

The test should be continued by abruptly switching from one direction of motion to another to see if this creates any complications for the youngster. During the course of testing, any apparent "leading" of one eye or the other should be noted if this can be observed. It should be noted to see whether the two eyes tend to team together during the act or whether one eye tends to lose fixation. Nystagmoid movements should be noted if observed

Characteristic head position during the test should be recorded. Excessive blinking or facial mannerisms should be noted if they occur. Any consistent tipping of the head into any unusual posture should be recorded.

Particular attention should be paid when the target crosses the mid-line. At this point there should be observation to see if there is any hesitancy or "skipping."

The above sequence should be done binocularly and should be repeated monocularly with each eye. Comparison should be noted between quality and type of response as done binocularly, monocularly with the right eye, and monocularly with the left eye.

SACCADIC FIXATION

Saccadic fixation should be tested utilizing the targets * supplied. The targets should be held at a distance of approximately twelve inches to fifteen inches from the child and should be oriented in the same direction as the movements in pursuit fixation. As in the case of pursuit fixation, the separation of the targets should be such that it is possible for the child to make the movements with eyes alone without a need for involving head or body movement. Separating the targets by a distance equal to the distance from the child will achieve this result.

Good saccadic fixation is characterized by accurate shifting of gaze from one target to the other. The eyes should move smoothly with a minimal overflow into head or body movements. The

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* One-half inch red and blue bead affixed to eight inch to twelve inch sticks.

movements should be made in a one part motion with accurate landing on each target in turn. The instructions to the patient are similar to those given for pursuit fixation. The child is instructed to "look at each bead as I call out the color. When I say red, look at the red bead and when I say blue, look at the blue bead." The observations made are similar to those made during testing for pursuit fixation with the additional factor of careful observation of the accuracy of the landing on each target. Another factor to watch for is to determine if the child anticipates the movement or waits for the command. If there seems to be a great deal of anticipation, the examiner can vary the timing as he calls one target or the other.

Just as in pursuit fixation testing, the procedure should be done initially binocularly and then monocularly with either eye. Comparison of the monocular and binocular performances should be recorded.

NEAR POINT OF CONVERGENCE

The near point of convergence should be checked by utilizing a bell on a stick as the target. The target should be held at eye level directly in front of the child at a distance of eighteen inches. The youngster should be instructed to watch the bell. The bell should slowly be brought toward the nose.

As the target is brought toward the child the examiner should watch for the following:

1. Are there signs of difficulty or effort such as nystagmoid movements, withdrawing from the task, frowning, tightness around the neck or jaws, motor overflow into face or body, excessive blinking, closing of one eye, covering of one eye?
2. At what distance do such difficulties commence?
3. What is the distance at which the eyes appear objectively to be no longer converging properly? Is release binocular or monocular? If monocular, which eye and in which direction.
4. Prior to total break, is binocular fixation constant or intermittent?

5. When convergence can no longer be sustained, do the eyes remain partially converged or do they go back to a parallel position?
6. Is there a report of diplopia while convergence appears to be maintained?_______at what distance?________
7. Is there a spontaneous report of diplopia when convergence is no longer maintained? If not, ask how many bells do there seem to be.

When the point has been reached at which binocular fixation is no longer maintained, the target should then be slowly withdrawn (the child instructed to keep looking at the bell) and the following observations noted:

1. At what distance do the eyes appear to regain fixation?
2. If the child has been aware of diplopia, report at what distance does the child report a return to single vision.
3. Is there any overconvergence before proper convergence is retained?

Repeat the procedure as outlined above, stopping the bell at a distance one inch further from him than the previously determined break point. Is convergence easily sustained at this point.

If the objective break point is greater than three inches or the objective recovery is greater than five inches, the child should then be instructed to try to keep both eyes working together and attempt to keep the target single for as long as he can. Record objective break and recovery with these new instructions.

At the break point, while the eyes are divergent, ask the child to touch the bell. Record effect of hand support.

NEAR FAR FIXATION

Using the bell on a stick, the child is asked to shift gaze abruptly from the near target held at eight inches to a single 20/30 Snellen letter at a distance and then back to the near target again. This should be repeated at least five times.

The shift should be smooth, easy, accurate, done with little or no overflow into general body movement, and done with a single smooth movement of each eye. Both eyes should release from the near target simultaneously and move to the far target simultaneously. The return movement back to the near target should also be done with both eyes simultaneously.

Close attention should be made to see whether both eyes release from the near target at the same time or whether one eye seems to lead in shifting from near to far or from far to near. If there is a lag of one eye behind the other eye, it should be observed. If one eye moves smoothly and the other eye does not move smoothly this should be observed. If one eye seems to get lost in route this should be observed.

See record form for questions for recording.

HOLE IN CARD TEST

At Distance

Use the card supplied (a hole one-half inch in diameter in a card 5" X 8" in size). Have the child hold it in both hands on his lap at arm's length. Display a small spot of light at a distance of 13 feet or more. Instruct the child to raise the card at arm's length and sight the spot through the hole. determine the eye used for this purpose by covering the right eye and left eye alternately while the card is held steady. Observe the following:

1. Which eye is used for sighting?
2. The manner in which the card is raised:
    directly to the eye
    in midline and then shifted off to side
    raised to midline and then held there and head shifted
    Is there a clear preference for one eye or are there several abortive movements before an eye is selected?
    Is one eye closed in order to achieve at this task?

Repeat the test 4 times.

3. Is initial behavior consistent throughout the 5 trials?

At Near

Repeat the test at near. Use the same card provided for distance test. Display a small penlight at a distance of 16 inches. Ask the child to raise the card midway between himself and the light, until the light is seen. Determine the eye used for this purpose either by observing the light shining on that eye through the hole, or by covering the eyes alternately while the card and penlight are held steady. Repeat the test 4 times, making a total of 5. Record the number of times the right eye was used and the number the left eye was used. Make the same observations required in the test with the target at distance.

WIRT STEROPSIS TEST

Use bright illumination. Test to be displayed at exactly 14 inches from the child's eyes. He is to wear his habitual near point correction, if any, and over that a pair of polaroid 3 D glasses, provided with the test. Have the child hold the card in his hand perpendicular to the line of sight. Avoid ghosts from tilting. Using the T D C square, be sure he understands the test. Ask the child whether one ball in the first square is closer than the other three "Which one?" He may point to it, or call off its number. Repeat for the A square and then for all squares from which a response can be obtained. Be sure to maintain a working distance of 14 inches, and bright illumination. Stop the test after two consecutive incorrect responses. The correct answers are on the record form. The near point stereopsis test (Titmus) may be substituted. Always record whether the response is immediate, slow, or very slow.

IDENTIFICATION OF SPECIFIC BODY PARTS

Ask the child to stand facing you. Tell the child to:

"Raise his right hand. Put it down."
"Pick up your left foot. Put it down."
"Touch your right knee with your left hand."
"Turn to the right."
"Point to my right hand."
"Touch my left ear."

Does the child respond correctly, with some difficulty, or poorly?

GENERAL COORDINATION

Hopping

Make sure there is at least 15 feet of space. Ask the child to hop to a predetermined place, such as, "Hop from here to the chair." Observe the following:

Does he hop with two feet together or does he hop on one foot?

Which one?

If both feet are chosen as the means of hopping, ask the child to hop on one foot observing which one and the skill with which he performs. Then ask him to hop on the other foot, making a like judgment.

One foot hopping is considered adequate when done easily, with no loss of balance, and good movement toward the goal.

Skipping

Ask the child to skip from one point to a designated point approximately 15 feet away. Observe the manner in which he does so. Does the child perform in free swinging, easy moving, good alternating skipping? Is he galloping or shuffling? Is the child able to skip backwards? Is there a refusal to skip backwards. Not many children will have experienced skipping backwards and it is interesting to see how long it takes them to process this activity in their minds before actually attempting it. It is revealing also to see whether they will attempt it at all.

TACHISTOSCOPE

Use a far or near point tachistoscope set for 1/25th second exposure. Set up for exposure of 3, one digit numbers and 5 each of two, three, four and five digit numbers.

Tell the child, "I am going to flash a number on the screen. Can you write down what it is?" Say "Ready" - "Now" separated by about 1.5 seconds. About 1.5 seconds later, flash the number. If not correct, repeat "Ready" "Now." Flash as many times as is necessary for the child to see the digit and write it down correctly. Be sure he understands the procedure. After the child has mastered the one digit numbers repeat for the 5 two digit numbers. Continue with the process up to the first set of digits where all 5 sets of numbers are incorrect. Record as indicated on the testing form. Record also make of tachistoscope used, distance of observation, and size of the digits as seen by the child.

COPY FORMS

A sheet of paper 8 1/2 X 11 is placed on the table oriented vertically with a pencil placed upon it. Tell the child "Put your name on the paper " The child is now told that a number of cards each with one design will be shown to him. (The cards are riffled in front of him).

The first card (circle) is placed flat on the table above his paper and he is told to "Make one like this on your paper." After the child has completed this figure, the remainder of the figures are presented in sequence as follows: cross, square, equilateral triangle, divided rectangle, horizontal diamond, and vertical diamond. The information that can be gained is listed on the record form for Part III.

The L.R.D. Test
(after Dr. Morton Davis)

This test was designed by us for the express purpose of checking special distortions and poorly developed directionality in young school children. This test can be administered two ways: by using a chalk board and then photographing the board, or by using paper and pencil. Since the chalk board eliminates some posture influence, we test in this manner. (In this study either procedure may be used.)

A line is drawn vertically, dividing the board (or 8 1/2 X 11 paper) in half. The child then is given a piece of chalk (or pencil) and asked to print an "A" on the right-hand side of the line. If he makes an error and uses the left side, say nothing to him. If he writes instead of prints, do not say anything. Allow him to continue in his own way. Then ask him to print a "B" on the left-hand side of the line, a "C" to the right of the "A", a "D" to the left of the "B," and so on, completely through the alphabet. (When the child catches on give him no further help unless he asks for it. If you have to give him every letter, record it on the back of his paper, or of the photo.)

The "finished" product should be:

Z X V T R P N L J H F D B / A C E G I K M O Q S U W Y

Do not allow the child to erase. If he sees that he has made a mistake, he can do it over along-side the original, but the first error must be in the record. Some of the major errors that appear are:

1. Reversal of letters; letters are sometimes printed upside-down or backwards.
2. The child may not know the alphabet in the proper order or may not know how to print. (Since these are pedigocical skills, we are sure to include this in our remarks on the teacher's report form.)
3. The child may not anticipate the space needed or the direction in which he is going to work.
4. The child may become confused switching back and forth or forget where he has made the previous letter.
5. The child switches his hands to write as he crosses the mid-line.

Individual cases will show up many other defects. We use this test on most children in the elementary grades and all cross-dominant and strabismus cases (some cross-dominants make no errors.)

Since this test has never been statistically validated, we do not have a pass or fail; we just use it as a method of recording changes in operation of the patient. If many errors show up, we say that the child cannot follow orders that require him to use space and directional clues on this type of task. I believe that if the test is properly evaluated, it could be a very useful tool, since this is a similar task to those the child performs at school.

I have found that many first grade children make many errors and as they grow and gain experience they do better even though they have not taken visual training. This makes me believe that we are measuring maturity of the development of visual direction and visual space.

Peg Board Form Test
(Myron N. Weinstein)

Materials: 2 12" X 12" masonite peg boards (holes 1" apart)
10 pegs

Test Procedure:

1. Make form (a) : while child cannot see what you
   are doing. .
2. Say to the child: Use your board and these pegs and make a picture (or design) like mine.
3. Remove pegs.
4. Make form (b) . . as above.
   .
5. Ask the child to copy as above.
   If the child reverses, explain the difference and give him a rotated (b) . . to copy.
   .
6. Remove pegs.
7. Proceed with (c) .
   .
   .

   If difficulty or hesitation is encountered repeat (c) rotated 90 degrees . .
   . .
8. Continue with (d) . and (e). . .
   . .
   .

Report:

1. Hand use (mainly right, mainly left, both).
2. Record the exact answers by drawing dots on the answer sheet to correspond to the peg placement.
3. Record the approach to solving the problem. Are the pegs placed sequentially from one end of the form to the other, or does the child begin solving the "problem" by first placing the middle peg.
4. Does the child tilt his head to judge the oblique lines.

The basic purpose of the test is to get some idea of how the child organizes visual information. Does he appreciate the "Gestalt" and reproduce it as such, or does he segment the form into its elements and "count holes"? Can he successfully cope with the oblique direction, or does he reduce the oblique to a vertical by tilting his head? Is the form correctly appreciated, but direction disregarded?

These questions bear on how the child will cope with written language; in my view, this simple test is often predictive of language difficulty.

SUPPLEMENTARY VISION TEST
(Optional)

BOOK RETINOSCOPE

The technique is as follows:

Use the second grade paragraphs which have been supplied. Have the child hold the card with the paragraph in his normal reading posture. Ask him to read aloud and indicate to him that he will be questioned about what he has read. Scope over the card in the same plane as the card. Scope one eye and then the other in the horizontal meridian only. Measure or estimate the dioptric value of the reflex. No deduction is made for working distance. Use single, hand held trial lenses for this purpose only. Record the gross amount of the reflex. Do not use lenses for remainder of procedure.

Three other factors must now be observed and recorded: the brightness of the reflex, the color of the reflex, and the motion of the reflex. Aspects to be observed and recorded are listed on the record form.

Changes in motion, brightness and color should be recorded if possible. If this cannot be done the predominant appearance in each category should be recorded.

Control of lighting during testing is important. The lighting should be adequate on the reading material but the face of the child should be dimly lit so that the retinoscopic reflex may be seen by the examiner.

KEY FORM BOARD

Without letting the child see the pegs in the holes, invert the board and scatter the pegs on the table before the child. Place the board directly in front of the child and say, "Put the pegs in the holes for me, please." If no attempt is made, place one in a hole for the child as a sample of what is to be done.

There are three modes of performance to observe as the child performs this task.

1. The first level is the trial and error level of performance. Judgment is made simply on the basis of which pegs go in which holes by a twisting trial and error basis.
2. The second level of performance is silhouetting. The child brings the peg above the hole and lines up the edge of the peg to the edge of the slot in a matching situation.
3. Visualization is the third and highest form of performance. The child picks up a peg, then while looking at the hole rotates his wrist and fingers, orients the peg in the proper direction and places the peg correctly.

APPENDIX F

MANUAL

VISUAL TRAINING SEQUENCE IN SCHOOL ACHIEVEMENT CASES

> Prepared for use in the study, "The Influence of Vision Training Upon the Subsequent Reading Achievement of Fourth Grade Children," by Dr. Henry Quick with the assistance of the participating optometrists.

This broad general outline of training procedures for school achievement problems is presented for the expressed purpose of generating some degree of uniformity for the study. It is not intended that all the procedures or even a majority of them are to be used in any given situation. It is also recognized that techniques vary according to the visual problem presented and to individuality of the patient and of the optometrist. This is essentially a guideline for the organization and the reporting of visual training procedures.

In view of the importance of this study to optometry, there are certain basic controls which should be recognized and adhered to. All training starts at the patient's achievement level and progresses horizontally and vertically toward higher levels of performance according to individual needs and conforming to the commonly accepted principles of learning.[1] Transfer of newly acquired skills to the everyday life of the child is essential and should be the primary consideration in any home training and other guidance that is necessary. Regular, prompt, well organized training periods with gentle yet firm control or discipline are a must. Motivation may be difficult to secure; or it cannot be adequately developed. If not present, this condition should be reported to the committee for permission to withdraw the candidate from the study. In all instances the program of training should incorporate the use of procedures which are within the purview of optometry - for example the use of lenses, prisms, occlusion and/or visual control or direction which is part of an optometrists training and understanding of the functional process of vision in general movement patterning. It is the consensus of the committee that procedures which fall in the normal activities of the remedial reading teacher not be added to the routine for this study. Words, reading material, etc. may be used wherever necessary. Specific areas to be avoided are phonetic training, vocabulary lists, reading pacers, reading textbooks, etc.

Detailed records of each training session are required. These should include the techniques, lenses, patient response and time. Home training assignments should also be noted. Records of the home training work as recorded by the patient or parent after the procedure followed in your office are to be part of the patient's file.

It is obvious that it would be impossible to enumerate and outline in detail the various training procedures and techniques in common use. Those that are cited as examples are to be found in the OEP papers, in the works of Getman,[2] Slade,[3] and in the training workshops and Congresses and implicit in Harmon.[4] The cataloging of the procedures into sections recognizes that there is a continuous interweaving throughout and that one technique may be used in more than one way simply by changing the controls. For example, a tactual-visual technique may be changed to a visual-tactual one by changing the principle control of movement from one that is kinesthetic dominant to a visually dominant one.

It is assumed that training lenses will be used at home and in the office in nearly every instance. All training should start monocularly, using the maximum amount of plus through which the child can achieve. There are two exceptions: (1) the embedded eso is trained monocularly through base in; (2) the embedded exo is trained binocularly through plus.

It is also assumed that good control of posture will be maintained at all times. As the child progresses through the training sequences the adequacy of any performance is expected to be maintained under the increasing demands placed upon it by the speech-auditory, body balance, identification, or centering components or by any combination of these four components.

Throughout the entire training program the patient must be exposed to the concept that he does not see to see but sees to act. He must learn to see with an 'eye full,' to utilize the peripheral as well as central vision, the concept of figure-ground structuring, the 'trees to forest ratio,' and the totality of space and its components. The ultimate objective is smooth, effortless, visual performance utilized without fatigue or excessive attention enabling the individual to use vision so efficiently that maximum effort is directed toward the purpose of vision and minimum effort toward the act of vision.

A. General Movement Patterns

1. Gross Motor Activity

   Object: To generate smooth, purposeful movements by establishing the control of all gravity responses and the coordination of head, torso and limbs, particularly in visually directed activities.

   Office Training: Indoctrination, instruction, practice and evaluation of any home training procedures which the optometrists selects on the basis of the patient's needs. Plus lenses.

   Examples: Crawling, hopping, jumping, Krause-Weber or Prudin, jump board, walking beam, chalkboard, skipping, crabwalking, Chinese socker, stilts, barrel walking, ladder, weighted helmet.

   Home Training: Regular practice periods of the procedures demonstrated in the office are assigned. Records are to be made and returned.

2. Reciprocity of Organismic Halves

   Object: The development of smooth synergistic and antagonistic movement patterns as visually directed activities.

   Office Training: Same as #1.

   Examples: Chalkboard-circles both hands, connect dots; Harmon sequence; balance board; gross fusion; coordination of hands on forms or blocks.

   Home Training: Same as #1.

   Examples: Ball rolling, bouncing, tossing, catching; jumping rope; right and left directions; spinning button on string; simple juggling; pick-up sticks; pie and pan and small sphere; paper folding; trampoline; hoolahoops.

3. Hand-eye Relationship

Object: To establish tactual-visual coordination

Office Training: Same as #1.

Examples: Any home training procedure; chalkboard-vertical or horizontal lines, star, push-pulls, running ovals; manual monocular rotations and fixations; tactual reproduction of forms, templates, tracing boards; acoustic tile and pegs; stacking boxes; playing inside boxes.

Home Training: Same as #1.

Examples: Rotations eyes closed; eyes fixed head rotating; Fixations eyes closed, eyes open head moving; Following wand in pursuit in all cardinal directions and around; HAS card (Van Orden: black card with white dots).

B. Ocular Motor:

1. Monocular Rotations and Fixations

Object: To restore the input-integrative-output-feedback response, starting well below any level of mobilizing experience.

a. Monocular rotations through plus

Office Training: Use squint korector or some rotating device, simple target. Goal is to have the eyes moving smoothly without fatigue, with body relaxed, posture good and the awareness that it feels right. With improving response more peripheral awareness is sought as well as the relationship to the total surroundings. Patient will progress from sitting to standing to walking beam to balance board. Float of spiral and more detailed targets like the TR groups under the control of the patient. Progressive utilization of speech-auditory, kinesthesia, and identification may be introduced.

Home Training: Monocular rotations with parent and then the child performing manually. Different controls may be introduced as needed and in accord with office achievement. Marsden Ball.

b. Monocular Fixations through plus

Office Training: Use TelEYEtrainer, #3 rotor, plus lenses to slight blur, increase plus as target clears. Calisthenic cards, small numbers at arrow points. Eye movements to be slow and easy. Change to #2, then #1. Patient is advanced to AN1, PG25, VO3. Numbers are called in order with rhythm, forwards and backwards. Smooth relaxed performance is required. At least ten cycles should be accomplished without fatigue or breakdown of rhythm. Then use a room star patterned after the above slides with patient standing, walking beam or balance board;helps in transfer.

Home Training: Rhythmic fixations on objects in familiar surroundings, then progressing to enforced fixations (near to far, indoors and outdoors). Naming words from book (1st - last per line) or (1st word then object in room).

2. Dissociated rotations

Object: To maintain both observed targets in unchanged spatial localization.

Office Training: Some instrumentation as in the beginning monocular rotations. Prism base up or base down is used in random position before either right or left eye, usually 10 diopters to start. These must be smooth, easy movements in all four positions with the two observed targets holding steady one above the other. There must be no vertical, lateral or axis shift. With progress the prism power is reduced. Control of speech, balance and identification are increased. Fused rotations with vertical prisms may also be used.

Home Training: Physiological Diplopia

Parallax routine - when fixing a pencil held in the hand two images of a distant object are seen and vice versa. Patient attempts to alternate fixations from far to near without suppressing, rhythmically about sixty times a minute, without winking. Time not to exceed one minute four times daily.

3. Binocular rotations and fixations with plus

   Object: Same as monocular

   Office Training: Essentially the same technique along with increasingly difficult controls are employed. In some instances better transfer is obtained by using projected rotary movements, or the room star with or without pointers.

   Home Training: Most monocular procedures. Brock String technique using rotations and pursuits in all cardinal directions, varying the distance. Room fixations with rhythm, tapping feet or upon direction.

4. Accommodative Rock

   Object: To establish the ability to easily, quickly and accurately change the focus from one distance to another. To restore the integrity of size constancy on a time space basis (Silo effect).

   Office Training: Use TelEYEtrainer, #3 rotor, Pine fusion card C3 or any similar line drawing, instrument set 2.50-16, R eye +2.25, L eye +2.75. Lenses are reversed at three minute intervals. Whenever plus side seems larger and farther away (no change during illumination period, no movement or clearing) effective lenses -.50, +.50 are used up to -2.00, +2.00.

   Home Training: Any combination of plus or minus, plano-minus, in hookovers with half blocks, loose lenses are mounted in holder to be shifted in a manner to obtain desired responses.

5. Modified Updegrave

   Object: To establish adequate degrees of freedom in the identification process.

   Office Training: In darkened room, plane of face and plane or material parallel, light flashing device with alternate cycles equal light-dark, material well below reading achievement level, large print, distance 13" plus sufficient to blur slightly. Patient strives to clear and DOES NOT read for meaning. Print should clear while light is on. When clear at start of flash patient moves away to point where it is again blurred but readable. When about 26" away move in to 13" increasing the plus to original blur and repeat. (We find it important during this procedure to have subject learn to perceive the letters (black) as though they were floating off the page. If light on dark background, then the letters are to be perceived as though the light were coming from behind like light through slits.)

Home Training: Duplication of the office procedure with appropriate lenses. The patient manually flashing the light in rhythm.

6. Binocular Routines

   Object: To improve quality of binocular integration extend ranges of binocular function (extend degrees of freedom, and to develop ability simultaneously to process imput for determination of special localization.

   a. Gross stereopsis - poloroid rings, anaglyph rings, with and without central control, at distance or on screen 5 - 6 ft. away. Varying degrees of difficulty are introduced. Near, far, intermediate.
   b. Suppressions: Brock luster series, Figural alternation (Retinal Rivalry).

7. Form field extension: A Perimeter, MacDonald card or any method to expand the operational form fields.

C. Visual Patterns

1. Cheiroscopic Drawing

   Object: To validate projection and output.

   Office Training: Standard instrumentation. Simple line drawings. Urge relaxation - patient not to force the situation. Do not allow patient to become frustrated. Tracing should be easy and efficient. There should be no lateral shifts, size should be good.

   Home Training: Practice in the making of size and distance judgments on familiar and unfamiliar objects at home and outdoors with verification and correction.

2. Eye-hand coordination

   Object: To bring in ground with kinesthesia

   Office Training: Telebinocular, correct eye scope, or stereoscope; cards PG25, AN1, VO3; Patient holds different colored pointers in each hand. Relaxation is stressed, with patient looking through hole in star. He is asked to see how many numbers can be called without turning his eyes. The numbers must be let in. Plus to slight blur is used. He is then asked to locate a certain number without turning his eyes; then he is directed to point both eyes to the tip of the star at that number. While doing so he places the pointers against the hood of the instrument and instructed to line up each pointer so that the tip is directly between the eye and the star point. They should appear to touch each other. He floats them down, smooth, easy and relaxed until they touch the card at the star point. Pointers should not disappear, lead the other or be displaced. Always stress the importance of seeing as many numbers and star points as possible indirectly. Repeat ten times forward and backward without fatigue or deterioration in performance. Proceed to AN3, VO4 and repeat. Location of numbers and star points on the "z" axis should be in evidence.

   Home Training: Specific tasks or application of the principles being taught into things the patient is interested in on a conscious level.

3. Van Orden Star

   Object: To build ground with range.

   Office Training: Correct eye scope or transilluminated box with stereoscope. Circles in the orthophoric position may be added if necessary. Patient is directed to look in the center of the circle or in the center of the undifferentiated space as though it were way off in the distance. He is to try to place the pencil in his right hand on the upper right hand dot and the pencil in his left hand on the lower left hand dot without turning his eyes. If not, he may turn his eyes. Then he is to return to the center, relax and try to see the pencils. He then starts them toward one another until they appear to meet in the center. He should endeavor to keep the pencils clear at all times without looking directly at them. The successive dots are repeated in turn. Ten runs are made on the same paper. Progress is measured by the clarity of the pencils, lack of suppression and the loci of the apicies within a 2m/m area around the orthophoric position of the instrument used.

4. Jump Ductions

Object: To extend latitudes in centering

Office Training: Plus to slight blur. Telebinocular, correct eye scope or stereoscope, cards EC5-8 and EC105-108, VO5-10 and VO11-14 or AN equivalent. Patient is directed to let the light come in - not to reach for it. As in all training techniques the objective is toward easy, effortless subcortical performance. Explain that the frame of reference should be thought of as the frame of a window, although not always parallel to him. Start where he can obtain fusion of both the top and lower scene. He should rock easily, maintain good crosses, and without suppression, slipping or displacement of one line nearer than the other; locate objects correctly in space in terms of the frame of reference and recognize and feel that one frame is nearer or farther away. Slides or cards are presented first base out or base in then base in and base out, alternately. If the progress of training up to this point is adequate the patient should be able to let himself perform, relax and let the scene come in all of the time with full appreciation of all the space. All scenes are to be clear.

Home Training: Vodnoy, orthofusor, keystone series.

5. Accommodative Rock

   Object: To extend latitudes in identification

   Office Training: Standard procedures - Van Orden high rock, Robbins Rock, Marsden Rock.

   Home Training: Alternate use of binocular plus and minus, near and far material - letter charts, clocks, calendars, pictures or printed material such as books, magazines or things of interest.

6. Form Perception

   Object: To organize and reinforce the skills of copying, matching, size, organization, recall and eye-motor performance.

   Office Training: Chalkboard and/or desk. Winter Haven templates,[5] Childcare Templates or Getman Templates.[6] Basically, the procedure used is set forth in the Procedure Manual, Winter Haven Lions Club, pages 43-45. This in reinforced with the use of parquetry blocks and Cuisennaire rods.[7]

   Home Training: Any of the office procedures, jig saw puzzles, identification of known and unknown objects in terms of matching, size and localization with adequate confirmatory feedback.

D. Visualization

1. Basic Forms

   Object: To aid in learning how one form can be made into other forms, pictures and objects by adding or subtracting lines, blocks or rods.

   Office Training: Same materials as C (6). Child is asked to make some animal, object or picture from the basic forms. The child is asked to build, change, take away or add to patterns available in parquetry blocks. The Cuisennaire rods are particularly useful at this stage especially where space and mathematics need reinforcement.

Home Training: Any office procedure. Simple puzzles (broken T), word building, verbal and/or visual predicting of results.

2. Tachistoscope

Object: To develop the ability to recognize and recall any viewed symbol by maximum visual appraisal with minimum auditory utilization.

a. Lyons[8] and Getman Series[9]

Office Training: The manuals of these basic series are followed in detail. There is one exception. Only rarely is an exposure longer than 1/100 second.

b. Localization, organization and identification

Office Training: Usually Far Tachistoscope. Slides of three to ten pennies, buttons, flowers, children, etc., in random position @ 1/100. Patient is to report the number he sees, how many heads or tails, holes or none, types of flowers, boys and girls, and where they were. The slides are then mixed and exposed without any pre-exposure set.

c. Geometric Forms

Office Training: Far Tachistoscope. One, two or three forms are used. Usually advisable to use unfamiliar forms in order that subvocalization is held to a minimum.

d. Digits, Words and Phrases.

Office Training: Far Tachistoscope until approaching adequate performance - then an intermixture of far and near instrumentation. Minimum performance six digits @ 1/100, seven digits desired.

Note: In recent years, in working with reading or other achievement problems, it has become our practice to have the patient repeat the alphabet or in some manner to utilize the speech mechanism as soon as some level of skilled visual performance has been achieved. We have found this very effective in eliminating vocalization or subvocalization from the reading act. With the tachistoscope, the alphabet is used with digits and the counting with letters, words, or phrases. If the initial work in preparation for this procedure at the visualization level has been introduced and integrated in the lower levels of the training procedures, little difficulty is encountered.

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APPENDIX G
FORMS USED IN THE STUDY

O.S.U. RF1603 Form #7

SYMPTOMS - CHILD INTERVIEW

Name of Child____________________________

1. Do your eyes ever bother you?______________________________

   ____

2. Do you ever have headaches?______________________________

   What are you doing when your head aches?____________________

   Where does your head ache?______________________________

   Does your head ache a little bit or a lot?____________________

   How long does the headache last?____________________________

   What time of day does your head ache?______________________

   What do you do to get rid of your headache?__________________

   When did you first notice these headaches?__________________

   Have you had headaches before this time?____________________

3. Is your vision ever blurred?______________________________

   Outdoors________Movies_________Chalkboard_____ Television__

   Reading_________Writing________Other________________________

   Is blur constant?_______________Is blur related to what you are doing?_________If so, what?______________________________

   Is your vision blurred sometimes when first looking up from reading or deskwork?____________________________________

5. Do you ever see two words or objects when you know there is just one there?_________If so, when?________________________

6. Do your eyes ever hurt?________If so, when?_________________

7. Do your eyes become tired?______If so, when?________________

8. Do your eyes water?________If so, when?____________________

9. Do your eyes burn or itch?______If so, when?_______________

10. Do you need to re-read in order to understand what you are reading____

11. Do you skip or re-read lines?________without meaning to?_____
12. Do you lose your place while reading?________________________
13. Do you like to use your finger as a pointer or use a marker while reading?________________________
14. Do you feel that it takes you longer to read your assignments than most of the rest in your class?________________________
15. Do you find it easier to remember what you are reading if you say the words aloud to yourself as you read?________________
16. Do you have a problem remembering what you have read?________
17. Do you have trouble remembering new words?________________
18. Are there certain words which are particularly hard for you to remember?________________________
19. Are there words which you have trouble telling apart?________ Which ones?________________________
20. When you are reading, do words "run together" or "jump"?_____
21. Do you have difficulty in copying work from the chalkboard even when you see it clearly?________________________
22. Do you have difficulty in finishing your assignments in school? __________At home?________________________
23. What sports are you good at?________________________
24. What sports are difficult for you?________________________
25. What do you like to do in your free time at home? Outdoors: ________________________Indoors:________________________

O.S.U. RF 1603 Form #8

Memorandum to Parents:

As you know, we are studying the reading and vision skills of your child. To do this carefully, we need information that only you can supply. Several of us have reviewed the questions carefully. We have included only those that are important. Please answer as many of the questions as you can. You may want to talk over some of the answers with the examining optometrist. You will have a chance to do this. Please do not ask these questions of your child and do not discuss the contents of this record with him/her. Give the best answers you can on the basis of your own observations.

Chas. B. Huelsman, Jr. Ph.D.
Ohio State University
Child Study Center

Lois B. Bing, D.O.S.
Chairman, Committee on The
Examination of Children
and Youth, A.O.A.

O.S.U. RF1603 Form #8 p. 2

CASE HISTORY FORM

A. Surname____

Date____________________ Grade__________ Phone______________

Birthdate_______________ Address_________________________

Age______________________ _________________________

Name of School_____________ Teacher's Name______________

B. Please describe your child's problem:______________________

____

____

____

____

____

____

____

____

____

C. Members of Immediate Family:

Name	Age	Birthplace	School or Occupation	Educ. or Grade
Father:				
Mother:				
Other children:				
1.				
2.				
3.				
4.				
5.				
6.				

Others living in the home:

1.____

2.____

D. Birth Data:

1. Was the Mother's health good during pregnancy?__________
2. Were there any complications before delivery?__________
3. Were there any complications during delivery?__________
4. Were there any complications after delivery?__________
5. Was pregnancy full term?____________________
6. Remarks:______________________________

E. Developmental Data:

1. Did your child crawl?____________________
2. When did (s)he start crawling?________________
3. Was the crawling easy and on "all fours"?__________
4. First walked:________________________
5. First said words:______________________
6. First used sentences:____________________
7. Was your child active as an infant?______________
8. Was your child in a play pen a lot or a little?________
9. Did your child handle himself with ease or was he awkward or clumsy?____________________
10. How is general coordination now?________________
11. How is manual dexterity?____________________
12. Which hand does your child prefer to use for eating?______
13. Which hand does your child prefer to use for writing?______
14. Was handedness ever changed?__________________

her her
15. Does your child readily know his right from his left?______

16. What are the athletic interests?______

______

17. What sports is (s)he good at?______

18. What sports is (s)he poor at?______

19. What activities does (s)he use for amusement when not at school or outdoors?______

______

F. Health and Physical Factors:

1. Is your child's general health good now?______

______

2. List illness and give dates when illnesses occurred, give highest temperature and duration of high temperature:

______

______

______

3. Is any medication being taken now?______If so, what?______

4. Has your child ever had convulsions?______Describe:______

______

5. Has (s)he had difficulty speaking clearly?______

6. Has (s)he given any evidence of not hearing?______

7. Has your child had injuries to the head or eyes?______
Describe:______

8. Sleep habits of your child:______

9. Have there ever been feeding problems?______

10. When were teeth last checked?______

11. Is any work needed on your child's teeth?________________

G. Environmental Factors:

1. To what extent did your child climb and play outdoors in pre-school years?________________

2. Was your child interested in using crayons, pencil and paper activities before entering school?________________

3. Was (s)he interested in being read to before and after entering school?________________

4. What are your child's free time interests?________________

____

5. What are the general family interests?________________

____

6. What language or languages are spoken in conversation in your home?________________

7. Attitude of child towards:

Parents:________________

Brother (s):________________

Sister (s):________________

Others in the household:________________

Other children:________________

Neighbors:________________

H. Educational Factors:

1. Age at time of entrance in school?________________

2. Did (s)he want to go to school?________________

3. Did (s)he start school in kindergarten or first grade?______

4. Did (s)he have difficulty in reading from the start?_______

5. Which are child's best subjects in school?________________

6. Which are child's poorest subjects in school?______________
7. Does your child get along well with the teacher?____________
8. Has your child had difficulty with a teacher in the past?___
9. Does your child get along well with classmates?____________
10. Has any remedial reading or tutoring been done in the school? ____
11. Has any remedial reading or tutoring been undertaken outside the school?______________________________
12. Has a grade ever been repeated?____________If so, which one and why?___________________________________
13. Has there been any attempt to adjust school work to the achievement level of your child?________________________
14. Has your child changed schools?____________If so, when and why?____
15. Has there been a frequent change of teachers?___________If so, when and why?__________________________________
16. Has your child been able to attend school regularly?_______ If frequent absences, why?____________________________

I. Ocular History:

1. When has there been a previous examination of your child's vision? By whom?__________________When?________________
2. What was the referring complaint?_________________________
3. What conclusion or diagnosis was given?____________________
4. What treatment was undertaken?___________________________
5. Were glasses previously prescribed?_______________________
6. When were these glasses prescribed?_______________________
7. What were the instructions given along with the glasses? ____

8. Did the glasses or previous visual treatment relieve the previous complaint?______________________________

9. How often have changes been made?______________________

10. If there was previous visual training, what was the purpose, the duration of the training, and the results?____________

____

J. Symptoms and Observations: (Please do not question child about these items. If you are not sure leave the question blank.)

1. In what way does your child seem to have visual difficulty?

____

2. In what way does your child complain about vision?________

____

3. Does your child ever complain of headaches?_______________

Location__________________Frequency______________________

Duration_____________Intensity ___________Time of day_____

Method of relief_______________________________________

Relationship of headaches to activity:_____________________

Date of onset of this complaint____________Previous history of a similar complaint___________________________________

4. Does your child ever complain of blurred vision?___________

Outdoors_______Movies_______Chalkboard________Television____

Reading________Writing______Other_________________________

Is blur constant?________Is blur related to use of eyes at a particular task?_________If so, what?_____________________

Is there blur when looking up from close work?_____________

5. Is there any double vision?______If so, when?_____________

____

6. Does your child ever complain of his eyes hurting?_________

If so, when?____

7. Does your child ever complain of his eyes tiring?__________
If so when?____

8. At what distance does your child usually hold reading
material?____

9. Does (s)he frequently close one eye?_____If so when?______
____

10. Does (s)he frequently cover one eye?______If so, when?_____
____

11. Are your child's eyes frequently bloodshot?____________If
so, when?____

12. Does (s)he rub eyes excessively?_______________________

13. Does (s)he have frequent styes?________________________

14. Does (s)he blink excessively?__________________________

15. Is there any unusual posture at writing?_________________

16. Is there any tilting of head at writing?_________________

17. Is there any unusual posture while reading?______________

18. Does (s)he tilt head while reading?_____________________

19. Is your child's span of attention adequate?______________

20. Is there avoidance of closework?________________________

21. Is there fatigue or listlessness after close work?_________

22. Is there any complaint of nausea, dizziness or car sickness?
_____If so, when?____

23. Is your child unusually sensitive to light?_______________

24. Are your child's eyes ever seen to either cross inward or to
deviate outward?____

25. Does (s)he complain of burning or itching of the eyes?______
If so, when?____

26. Does your child trip or stumble frequently?_______________

27. Does your child dislike reading and reading subjects?______

____

28. Is there any voluntary reading other than that which is required in school?______

29. Does (s)he need to re-read in order to comprehend what is read?______

30. Is there skipping or re-reading lines?______

31. Is there losing place while reading?______

32. Is there slow reading or word calling?______

33. Does (s)he desire to use finger or marker while reading?______

34. Does (s)he move lips or read aloud during silent reading?______

35. Does your child reverse in reading (confuses "was" with "saw" "no" with "on")?______

36. Is there inability to remember what has been read?______

37. Does your child learn new words "by sight" easily or only after considerable repetition?______

38. Does your child complain of letters and lines "running together" or of words "jumping"?______

39. Are there frowning, squinting, or other facial distortions while reading?______

40. Are there excessive head movements while reading?______

41. Does your child confuse words which look similar?______
Which ones are most frequent?______

42. Does your child write with face too close to work?______

43. Are there signs of tension during close work?______

44. Does your child have difficulty in copying from the chalkboard?______

45. Does your child have difficulty in finishing assignments in school or at home?________________________________

46. Does your child do well in: arithmetic?_____Spelling?______
Social Studies?__________ Handwriting?____________________

Check any of the following items which apply to your child:

____Selfish
____Daydreams
____Discouraged
____Stealing
____Shyness
____Sensitiveness
____Quarrelsome
____Restless
____Unhappy
____Destructive
____Fails to get along with others

____Temper Displays
____Inattentive
____Untruthful
____Truancy
____Sex misbehavior
____Nail biting
____Bed wetting
____Clothes wetting
____Speech defect
____Fearfulness
____Depressed

____Disobedient
____Sulky
____Running away from home
____Thumb or finger sucking
____Lack of bowel control
____Feeding problems
____Sleep disturbances (sleep walking, nightmares, etc
____Suspiciousness
____Cruelty
____Bullying

____Overcritical, ridicules others
____Nervous
____Unreliable
____Lacks interest in work
____Attracting attention
____Imaginative lying
____Tics, muscle twitching, fidgeting
____Boastful
____Inferiority feelings
____Crying
____Overactive
____Vomiting

Vision Analysis Record

O.S.U. RF 1603 #9R

Name__________________________________Date________________

Address_________________________________Year of Birth________

____

School______________________Optometrist__________________

Old Rx	Visual Acuity with old Rx	Naked Vision Distance	Near 14"	Child's preferred distance
O.D.	O.D.	O.D.	O.D.	O.D.
O.S.	O.S.	O.S.	O.S.	O.S.
	O.U.	O.U.	O.U.	O.U.

State of health of eyes and adnexia:

Ophthalmoscope:

P.D. Dist. / Near /

Exam				Observations
2	Ophthalmometer			
	O.D.			
	O.S.			
3	Habitual Phorias			
	Dist.	Near (13A)		
4	Static Ret.	O.D. O.S.		
5	Dyn. 20"	O.D. O.S.		
7	Subj.	O.D. O.S.	V.A. O.D. O.S. O.U.	

Name________________________________Date____________

Exam Observations

8 Induced Phoria

9 True Adduction 1st Blur Blur Out

10 Convergence / / / /

11 Abduction / / / /

12 Vertical Phoria Vertical Ductions O.D. $\frac{S}{1}$ O.S. $\frac{S}{1}$

13B Induced Phoria Through Subjective

14A Cross Cyl. Disso- ciation O.D. O.S.

15A Induced Phoria

14B Cross Cyl. Binocular O.D. O.S.

15B Induced Phoria

16A Tol. Add. Stim.

16B Pos. Fus. Res. / / / /

17A Tol. Add. Inhib.

17B Neg. Fus. Res. / / / /

18 Vertical Phoria Vertical Ductions O.D. $\frac{S}{1}$ O.S. $\frac{S}{1}$

19 Amp. Acc. O.D. O.S. O.U.

20 Tol. of Acc. Stim.

21 Tol. of Acc. Inhib.

22 / /

O.S.U. RF1603 Form #10

VISUAL PERFORMANCE TESTS RECORD FORM

Name of Child________________________________Date__________

Name of Optometrist______________________________________

Book Retinoscope:

i.
1. Distance that patient holds material_________
2. Estimated or measured gross dioptric value of reflex in horizontal meridian.

   Righ eye_____ Left eye_____
3. Quality of motion: Record:
   - a. A rigid, constant against motion.
   - b. A rigid, constant with motion.
   - c. A stable shifting back and forth between against and neutral.
   - d. A stable shifting back and forth between with motion and neutral.
   - e. An unstable shifting back and forth between against and with, no neutrality shown at all.
   - f. A flexible shifting back and forth among against, neutral, and with motion.
4. Brightness: Record:
   - a. A rigid, unchanging reflex of high brightness.
   - b. A rigid, unchanging reflex of average brightness.
   - c. A rigid, unchanging dull reflex.
   - d. Small, stable changes back and forth between bright and average.
   - e. Small, stable changes around average brightness.
   - f. Small, stable changes back and forth between average and dull brightness.
   - g. Widely unstable changes from high brightness to dull and back and forth without appearance of average brightness.
   - h. Flexible changes from bright to average to dull and from dull to average to bright going through each level with each level of brightness easily identified.
5. Color: Record:

a. White	b. Whitish-pink
c. Pink	d. Reddish-pink
e. Red	f. Deep red

Changes in motion, brightness, and color should be recorded if possible. If this cannot be done the predominant appearance in each category should be recorded. (Example: Patient might start off showing motion, brightness, and color described by #3-b, #4-a, #5-a which changed after a few moments to #3-a, #4-d, #5-c.

O.S.U. RF1603 Form #11R

RECORD FORM VISION TESTS PART III

Name of Child________________________________Date______________

Name of Optometrist____

An "X" before a number or an item means inability to secure a valid answer.

	O.D.		O.S.		O.U.	
1. Pursuits:	Yes	No	Yes	No	Yes	No
1. Is the child able to follow the moving target at all?						
2. In what direction is the following the smoothest?						
3. Can the following be sustained for an adequate length of time?						
4. Does the following become more accurate with time?						
5. When the child is not following the target accurately is the "missing" gross?						
6. Does the type of missing remain constant?						
7. Does the child tend to overshoot?						
Does the child tend to undershoot?						
8. Is there head turning in place of eye movement?						
If so, is the eye movement accurate with the head turning?						
If so, do eyes seem to be leading the head?						
If so, is head movement supporting to the eye movement?						
If so, does the head move in the proper direction?						
If so, is there an overflow into body movement?						
If so, does the child seem to be aware that his head is moving?						

4

	O.D.		O.S.		O.U.	
	Yes	No	Yes	No	Yes	No
If so, does the head movement persist in all meridians of gaze?	___	___	___	___	___	___
Does head movement increase with time?	___	___	___	___	___	___
Does head movement decrease with time?	___	___	___	___	___	___
9. Does the child make verbal comments during the testing?	___	___	___	___	___	___
10. Is the child aware of when he is actually aiming properly?	___	___	___	___	___	___

11. Which change in instructions was utilized?

12. What was the change in response?

13. When the child touches the bell:

    a. Does he touch_____hit_____pinch_____or scoop from behind?_____

    b. Does he use full hand_____2-finger pincher grasp_____ or single finger_____to touch?

14. When the child uses forefinger in contact with the bell:

    a. What is the affect of hand support? Improved_____ None_____Worse_____Comment_________________________________

    b. What is the affect of abruptly switching direction?

        severe loss of control_____
        mild loss of control_______
        no loss of control_________

15. In general the pursuit fixations may be described as: Failure_____Poor_____Fair_____Good_____Excellent_____

16. Record characteristic head position, excessive blinking, facial mannerisms or any other overt performance. Record any hesitancy or skipping as target crosses midline.

	O.D.		O.S.		O.U.	
	Yes	No	Yes	No	Yes	No
2. Saccadics:						
1. Are fixations accurate in all meridans?	__	__	__	__	__	__
If not, which are not?						
Vertical	__	__	__	__	__	__
Horizontal	__	__	__	__	__	__
Oblique	__	__	__	__	__	__
If not, does he undershoot?	__	__	__	__	__	__
If not, does he overshoot?	__	__	__	__	__	__
If not, is it a "near miss?	__	__	__	__	__	__
If not, is it a gross misalignment?	__	__	__	__	__	__
2. Do fixations become more accurate with time?	__	__	__	__	__	__
Do fixations become less accurate accurate with time?	__	__	__	__	__	__
3. Is there head turning in place of eye movement?	__	__	__	__	__	__
If so, is eye movement still inaccurate?	__	__	__	__	__	__
If so, do eyes dead the head?	__	__	__	__	__	__
If so, is it supporting eye movement?	__	__	__	__	__	__
If so, does the head move in the proper direction?	__	__	__	__	__	__
If so, is there an overflow into body movements?	__	__	__	__	__	__
If so, does the child seem to be aware of his head movement?	__	__	__	__	__	__
If so, does it persist in all meridians of gage?	__	__	__	__	__	__

	O.D.		O.S.		O.U.	
	Yes	No	Yes	No	Yes	No
Does the head movement increase with time?	___	___	___	___	___	___
Does the head movement decrease with time?	___	___	___	___	___	___

4. Does the child make verbal comments during testing Yes____ No____

5 Is the child aware of when he is actually aiming properly? Yes____ No____

6. In general the saccadic fixations may be classified as

Fail____Poor____Fair____Good____Excellent____

3. Near Point of Convergence:

1. Are there signs of difficulty or effort such as nystagmoid movements, withdrawing from the task, frowning, tightnes around the neck or jaws, motor overflow into face or body, excessive blinking, closing of one eye, covering of one eye? If so, report which observations are made.________________

2. At what distance do such difficulties commence?

3. What is the distance at which eyes appear objectively to be no longer converging properly_____inches or______cm? Is release binocular or monocular?________________If monocular, which eye and in which direction?__________________________

4. Prior to total break, is binocular fixation constant______or intermittent?______

5. When convergence can no longer be sustained, do the eyes remain partially converged or do they go back to a parallel position?____________________

6. Is there a spontaneous report of diplopia when convergence is no longer maintained? Yes_____No_____ If not, ask how many bells does there seem to be. Sees: 2_____1_____

When moving the bell away:

7. At what distance do the eyes appear to regain fixation?______

8. If the child has been aware of diplopia, at what distance does the child report a return to single vision?_____________

9. Is there any overconvergence before proper convergence is regained? Yes_____No_____

Is convergence for a point one inch further than the break point easily sustained? Yes_____No_____

With instructions to maintain convergence:

Objective release point_____Objective recovery point_____

Effect of hand support____________________________________

4. Near - Far Fixation:

1. On shift from near to far:

a. Do both eyes release and fixate equally? Yes____No____

b. If no, right eye overholds_____lags_____leads_____ overreaches_____.

c. If no, left eye overholds_____lags_____leads_____ overreaches_____.

2. On shift from far to near:

a. Do both eye release and fixate equally? Yes_____No_____

b. If no, right eye overholds_____lags_____leads_____ overreaches_____.

c. If no, left eye overholds_____lags_____leads_____ overreaches_____.

5. Sighting Eye:

1. Which eye is used for sighting?

Distance 1.______2.______3.______4.______5.______

Near 1.______2.______3.______4.______5.______

2. The manner in which the card is raised:

a. Distance

directly to the eye_____
in midline and then shifted off to side_____
raised to midline and then held there and head shifted_____
Is there a clear preference for one eye_____ or are there several abortive movements before an eye is selected?_____
Is one eye closed in order to achieve at this task? Yes_____No_____

b. Near

directly to the eye_____
in midline and then shifted off to side_____
raised to midline and then held there and head shifted_____
Is there a clear preference for one eye_____ or are there several abortive movements before an eye is selected?_____
Is one eye closed in order to achieve at this task? Yes_____No_____

6. Near Point Stereopsis

Wirt   Titmus

A________3
B________3
C________2
D________1
E________4
F________1
G________2
H________4
I________1
J________3

Response was immediate,_____slow,_____very slow_____

7. Identification of Body Parts - Specific

Performance: Responds correctly_____; with some difficulty_____; poorly_____. Comments:

8. General Coordination

a. Hopping: Spontaneous choice: 2 feet____right foot____ left foot____

Demanded one-footed hop: right foot____ left foot____

Quality of preferred foot hop: good____ fair____poor____

Quality of hop of other foot: good____ fair____poor____

b. Skipping: Free swinging, easy moving: Yes____No____

Galloping or shuffling: Yes____No____

Backwards: Yes____No____

Comments:

9. Tachistoscope:

Digits	# Wrong	# Reversed	# Correct
1.__________	______		______
2.__________	______	______	______
3.__________	______	______	______
4.__________	______	______	______
5.__________	______	______	______
6.__________	______	______	______

10. Copy Forms:

1. Which hand is used for writing? Right____Left____
2. Was the orientation of the paper changed? Yes____No____
   If so, describe______________________________
3. Is there a head tilt while copying? Yes____No____ If so, describe______________________________
4. What is working distance?__________Does this remain constant? Yes____No____ If not, describe change__________
   ____
5. Is the circle reproduced with a clockwise_____or a counter-clockwise_____stroke?
6. Is the paper rotated during the copying of any of the figures? Yes____No____ If so, describe______________
   ____
7. Does the child reproduce the figures after a single look? If not, which figures are rechecked? If there is frequent rechecking list the figures which cause this response._____
   ____
8. Are the internal lines of the divided rectangle drawn with continuous lines? Yes____No____

9. Are the horizontal and vertical diamonds drawn with appropriate orientations? Yes____No____

10. Are there any unusual postures or positions? Yes____ No____. If so, describe____
____

11. Is non-writing hand utilized to hold or guide paper?

12. Record any other significant observation.

11. L.R.D. Test (Davis)

1. Check one of these

_____a. Child followed directions without extra instructions.

_____b. Child asked for help.

_____c. Child needed help, but did not ask.

2. Does the child reverse any letters? Yes____No____ If so, which ones?____

3. Does the child know the alphabet? Yes____No____ Errors:____

4. Does the child know how to print? Yes____No____

5. Does the child anticipate space needs? Yes____No____

6. Does the child become confused? Yes____No____ Describe:
____
____

7. Does the child switch hands as he crosses midline? Yes____No____

8. Other Observations:

12. Peg Board Form Test

a) . Correct____Incorrect____ _________________
.
.

b) . . Correct____Incorrect____ _________________
.

c) . Correct____Incorrect____ _________________
.
.

. . Correct____Incorrect____ _________________
.

d) . Correct____Incorrect____ _________________
.
.

.
e) . . . Correct____Incorrect____ _________________
.

1. Hand used: Right____Mainly Right____Both____
Mainly Left____Left____

2. Approach to solving problem:
_____Sequential placement left to right
_____Sequential placement right to left
_____Middle peg first

3. Does the child tilt head to judge oblique lines?
Yes____No____

4. Other Observations:

13. Key Form Boards (optional):

Type of performance: Trial and Error_____; Silhouetting____
Visualization_____.

Supplementary observations made during the test.

Does the child pick up peg with thumb and index finger? Yes_____No_____

Are both hands involved in the activity? Yes____ No____

Does he pass the pegs from one hand to the other? Yes____ No____

Does he hold the block with one hand and place the pegs with the other? Yes____No____

Does he ever reverse the role of the hands? Yes____No____

O.S.U. RF1603 Form #12

To: Chas. B. Huelsman, Jr.
Child Study Center
65 South Oval Drive
Columbus 10, Ohio

From: ________________________________
____
____

Phone __________

I completed the vision examination of ________________________
from __________________________ School on ____________________ (date).

I have enclosed the following forms:

No. 7	______	Keystone telebinocular	______
No. 8	______	Cheiroscopic drawing	______
No. 9	______	Book Retinoscopy	______
No. 10	______	Results of additional tests selected by optometrist	______
No. 11R	______		

In view of these findings, I think this student has a vision problem which may be classified as

______1. No vision problem.

______2. A vision problem which is unrelated to the referring complaint of reading retardation.

______3. A vision problem related to the referring complaint but not trainable in the judgment of the examiner.

______4. A vision problem related to the chief complaint but a condition existing wherein the examiner feels that there are additional complicating factors other than the need for vision training and remedial reading.

______5. A vision problem related to the reading retardation which will probably respond to vision training alone.

______6. A vision problem related to the reading retardation which will probably require vision training and also remedial reading therapy.

Vision training probably should be completed within ______ weeks.

Comments on the reverse side